TOWN OF NANTUCKET
CONSERVATION COMMISSION

WETLAND PROTECTION REGULATIONS

FOR ADMINISTERING THE TOWN OF NANTUCKET BYLAW CHAPTER 136

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PART I - GENERAL PROVISIONS

1.01 INTRODUCTION AND PURPOSE

A. INTRODUCTION

These regulations are promulgated by the Town of Nantucket Conservation Commission (hereinafter referred to as the "Commission") pursuant to the authority granted to it under Section 136-7 of the Town of Nantucket Bylaw for Wetlands (hereinafter referred to as the "Bylaw"). The regulations should be read together with the Bylaw, which has many important provisions not to be repeated in these regulations. These regulations shall be used to enforce and implement the Bylaw, and shall have the force of law upon their effective date. These regulations supersede all existing rules and practices previously applicable to procedures and proceedings before the Commission.

B. PURPOSE

The purpose of these regulations is to establish definitions, design standards, and uniform procedures by which the Nantucket Conservation Commission is to carry out its responsibilities under the Bylaw.

1.02 DEFINITIONS

The definitions in Section 1.02 of these regulations are for terms as used in the Bylaw and for terms as used in these regulations. To the extent not defined herein or in the Bylaw, words used in the Bylaw or in the regulations shall have the definitions contained in the Massachusetts Wetlands Protection Act (M.G.L. c. 131, sec. 40) and the rules and regulations promulgated thereunder.

Abutter - an owner of land in any direction sharing a common boundary with the site of the proposed activity, including any land located directly across a street, way, stream, pond, or diagonally across from an intersection of roads. A landowner more than 300 feet across a pond shall not be considered an abutter.

Activity - same as the definition of work.. All activities set forth in the Bylaw, Section 136-3A, including altering, removing, filling, dredging, or building upon.

Adverse Impact- means a greater than negligible change in the resource area or one of its characteristics, functions or factors that diminishes the value of the resource area to one or more of the specified interests of the Town of Nantucket Wetland Protection Bylaw (Chapter 136), as determined by the Commission. “Negligible” means small enough to be disregarded and shall be defined in relation to the wetland resource areas impacted.

Agricultural Practices –

(1) Land in agricultural use – Any qualifying wetland within a farm which is qualified or eligible to be qualified under the Farmland Assessment Act, MGL c. 61A §§ 1 through 5.

(2) Qualifying Wetland – Only inland freshwater areas which are seasonally flooded basins or flats or inland fresh meadows.

(3) Normal maintenance or improvement of land in agricultural use:

(a) Shall mean only:

[1] Tilling practices customarily employed in the raising of crops.

[2] Pasturing of animals, including such fences and protective structures as may be required.

[3] Use of fertilizers, pesticides, herbicides and similar materials, subject to state and federal regulations covering their use.

[4] Construction, grading or restoring of field ditches, subsurface drains, grass waterways, culverts, access roads and similar practices to improve drainage, prevent erosion, provide more effective use of rainfall and improve equipment operation and efficiency in order to improve conditions for the growing of crops.

(b) "Improvement of land in agricultural use" may also include more extensive practices such as the building of ponds, dams, structures, for water control, water and sediment basins and related activities, but only where a plan for such activity is approved by the Conservation District of the Soil Conservation Service is furnished to the Conservation Commission prior to the commencement of work. All such activity shall subsequently be carried out in accordance with said plan. In the event that the work is not carried out in accordance with the required plan, the Conservation Commission may place a stop order on said work and have recourse to such measures as if the plan were an order of conditions.

Alter - includes, without limitation, the following actions when undertaken in areas subject to this chapter: Removal, excavation or dredging or soils, sand, gravel, or aggregate materials of any kind. Changing drainage characteristics, flushing characteristics, salinity distribution, sedimentation patterns, flow patterns, and flood-retention characteristics. Drainage or other disturbances of water level or the water table. Dumping, discharging, or filling with any materials which may degrade water quality. Driving of piles, or erection of buildings or structures of any kind. Placing of obstructions, whether or not they interfere with the flow of water. Destruction of plant life, including cutting trees. Changing of water temperature, biochemical oxygen demand, or other physical or chemical disturbances of the water. Placing of fill, or removal of material, which would alter elevation. Any activity, changes, or work, which causes or contributes to the pollution of a body of water or groundwater. Application of herbicides, or fertilizers other than in agricultural use. Incremental activities which have a cumulative adverse impact on the interests protected by this chapter.

Applicant - the individual filing the Nantucket Notice of Intent, or Nantucket Request For Determination of Applicability or other request for action and/or permit or permit modification to the Commission.

Aquatic Vegetation – any rooted or free floating plant that spends a portion of its life cycle either emersed or submersed by water

Areas Subject to Protection - land areas and/or water bodies subject to protection under the Bylaw, as set forth in Section 136-3 of the Bylaw.

Bank (coastal) - the seaward face or side of any elevated land form, other than coastal dune, which lies at the landward edge of a coastal beach, coastal dune, land subject to tidal action or coastal storm flowage, or other coastal wetland. Any minor discontinuity of the slope notwithstanding, the top of the bank shall be the first significant break in slope as defined by site specific topographic plan information, site inspection, wetland habitat evaluation, geologic origin, and/or relationship to land subject to coastal storm flowage. A bank may be partially or totally vegetated, or it may be comprised of exposed soil, gravel, stone, or sand. A bank may be created by man and/or made of man-made materials. A bank may or may not contribute sediment to coastal dunes, beaches and/or to the littoral drift system. A bank may be significant as a major source of sediment, as a vertical buffer, for wildlife habitat and for wetland scenic views.

Bank (inland) - the portion of land surface that normally abuts or confines a water body. A bank may be partially or totally vegetated, or it may be comprised of exposed soil, gravel, stone, or sand. The physical characteristics of a bank, as well as its location, are critical to the protection of wetland interests. The upper boundary of a bank is the first observable break in slope above the ten-year flood level. The lower boundary of a bank is the annual high water elevation of the water body. A bank may be created by man and/or made of man-made materials.

Beach - unconsolidated sediment subject to wave, tidal, or storm action which forms the gently sloping shore of a body of water, including land which is separated from other land by a body of water or a marsh system. Beaches extend from the mean low water line landward to the dune line, bank line, or the edge of existing man-made structures, when these structures replace one of the above lines, whichever is closest to the defining water body.

Best Available Measures - the most up to date technology or the best designs, measures, or engineering practices that have been developed and that are commercially available.

Best Practical Measures - technologies, designs, measures, or engineering practices that are in general use to protect similar interests.

Boathouse - Any structure on or near the water used exclusively for the storage and maintenance of boats, with related items. A boathouse may not contain habitable space.

Boathouses shall not be used for storage or maintenance of boats trailered to or from off-site.

Bog - areas where evidence of depth to high groundwater is within 18 inches of the ground surface during a normal growing season, and/or where soils exhibit hydric characteristics, and/or where a plant community has a significant portion of the ground or water surface covered with Sphagnum moss (Sphagnum) and where the plant community is made up of a significant portion of one or more, but not limited to nor necessarily including all, of the following plants or groups of plants: aster (Aster nemoralis), azaleas (Rhododendron canadense and R. viscosum), bog cotton (Eriophorum), cranberry (Vaccinium macrocarpon), high-bush blueberry (Vaccinium corymbosum), laurels (Kalmia augustifolia and K. polifolia), leatherleaf (Chamaedaphne calyculata), orchids (Arethusa, Calopagon, Pagonia), pitcher plants (Sarracenia purpurea), sedges (Cyperaceae), sundews (Droseracae), and sweet gale (Myrica gale).

Bordering - touching at any point.

Boundary - the boundaries of an area subject to protection under the Bylaw.

Building Upon - construction of any kind of structure, whether on land or in water; placing of obstructions or objects in water (other than boats, moorings, fish or shellfish traps, pens or trays used in conjunction with aquaculture, or aids to navigation).

Bylaw - Chapter 136 of the Code of Nantucket Bylaws entitled “Wetlands.”

Certificate of Compliance (Nantucket) - a written determination by the Commission that the proposed work or portion thereof has been completed as required by a Permit. In some instances a Certificate of Compliance may also be issued stating that no work has been undertaken or completed within the timeframe allowed by the Permit issued.

Coastal Dune - any hill, mound, ridge, or field of ridges, hills, or mounds, composed of sediment, any portion or component of which over the course of a year touches upon, exchanges sediment with, and is landward of a coastal beach deposited by wind action, storm overwash, and/or is man-made.

Coastal Dune Field – an assemblage or grouping of coastal dunes, at least a portion of which over the course of a year touches upon, exchanges sediment with, and is landward of a coastal beach, that may or may not be oriented parallel to the shoreline or in response to a dominant wind direction but has been deposited by wind action, wave action, and/or by storm overwash.

Coastal Wetland - any bank, beach, dune, estuary, marsh, swamp, meadow, flat, or other lowland subject to tidal action or coastal storm flowage from the ocean or an estuary.

Commission or Conservation Commission - Nantucket Conservation Commission as a body of members lawfully appointed pursuant to M.G.L. c. 40 s. 8c.

Conditions - those requirements set forth in a written Permit issued by the Commission for the purpose of permitting, regulating, or prohibiting any activity that alters an area or adversely impacts an interest subject to protection under the Bylaw.

Creek - same as a stream.

Date of issuance - the date the Permit, Determination, or a Certificate of Compliance is mailed, as evidenced by a postmark, or the date it is hand delivered.

Department - Massachusetts Department of Environmental Protection, DEP.

Depth to Groundwater - shall be determined by best information available, including but not limited to the methods listed below:

1) direct observation of highest groundwater elevation (including seasonal and perched groundwater),
2) direct observation of mottling (redoximorphic features),
3) by calculation using the USGS Frimpter high groundwater adjustment method.

Determination of Applicability (Nantucket) - a written finding by the Commission as to whether the Bylaw is applicable to any work, as permitted in Section 136-3D of the Bylaw.

Dredge - to deepen, widen, or excavate either temporarily or permanently.

Dune - any hill, mound, or ridge of sediment landward of a coastal beach deposited by wind action, storm overwash, or man-made. Coastal dunes are significant for flood control, as a sediment supply to down drift coastal resource areas, for rare/significant habitat, for recreation, and for wetland scenic views.

Elevated walkway – any structure that ends landward of Mean High Water, used for pedestrian access over a Salt Marsh, Coastal Dune, Coastal Dune Fields, Coastal Banks, Bordering Vegetated Wetlands, Filled and Flowed Tidelands. This definition is to include Beach Stairs.

Engineering Structure - any bulkhead, revetment, wall, rip-rap, groin, jetty, plastic sheeting, or other structure intended, or constructed so as, to prevent, alter, alleviate, or contribute to storm damage or modify wave action, littoral flow, erosion, surface water pollution, or groundwater quality or flow.

Eroding shoreline - any beach, coastal bank, or dune the waterside edge of which has undergone a net retreat due to water and wave action over a six-year period ending on the date on which an application is filed.

Erosion Control - the prevention or reduction of the detachment or movement of soil or

rock fragments by water, wind, ice, and/or gravity.

Estuary - any area or partially enclosed coastal body of water where fresh and salt water meet and mix and where tidal effects are evident.

Existing - begun or completed prior to the effective date of these regulations, or in accordance with permits issued under these regulations.

Extension Permit - a written extension of time within which the authorized activity shall be completed, as permitted by Section 136-4B of the Bylaw.

Fill - to deposit any material so as to change any grades or raise an elevation, either temporarily or permanently.

Fisheries - all species of fresh and saltwater finfish including the nutrient sources and habitat in which they live all or part of their life cycle.

Flat - any nearly level part of a shoreline or coastal beach that usually extends from the extreme low-water line landward to the more steeply sloping face of a coastal beach or bank. The flat may be separated from the beach by land under the ocean.

Flood Control - the prevention or reduction of flooding and flood damage.

Freshwater Wetland - a wet meadow, freshwater marsh, swamp, bog, pond, lake, creek, or stream; an area of low topography where ground water, flowing water, standing surface water, or ice provides a significant part of the supporting substrate for a plant community for at least five months of the year; characterized by emergent and submergent plant communities in inland waters; and/or where depth to high groundwater is within 18 inches of the ground surface, and/or exhibits hydric soil characteristics and includes that portion of any inland bank which touches any freshwater wetland. Freshwater wetlands are not defined to include drainage facilities constructed to include wetland vegetation as treatment from stormwater runoff.

Grandfathering/Pre-existing Use - allows that the use and normal maintenance of any structure or alteration of land, within wetland resource areas and their buffers, existing at the time of enactment of MGLCh131s40 (effective date 1972) or the Town of Nantucket Wetlands Protection Bylaw (effective date 1983), or subsequent revisions, may be continued subject to the following:

- existing structures, uses and/or alterations of land may not be extended and/or modified unless such extension or modification is permitted by a finding of the Commission that such alteration or modification shall have no adverse impact to the resource areas and interests protected by the Town of Nantucket Wetlands Protection Bylaw.

- existing structures, uses and/or alterations of land which have been abandoned for

five years or more shall not be reestablished, and any future use shall conform with then-current provisions of the Town of Nantucket Wetlands Protection Bylaw, as appropriate.

Maintenance and/or repair to existing onsite sewage disposal systems and wells is excluded from this definition.

Ground Water - water below or seeping from the earth's surface in the zone of saturation.

Habitat – Where wildlife find what they need to survive: food, water, cover from predators and weather, breeding and rearing areas, and over-wintering areas.

- Habitat includes any portion of any wetland resource area:

  (1) Within which are located any species (plant or animal) recognized as significant by the Commission following a public hearing thereon;
  (2) Which falls within any of the most recent state estimated habitat maps, adopted by the Commission following a public hearing thereon.

- All flora and fauna listed by the Massachusetts Natural Heritage and Endangered Species Program and their environs shall be considered significant to the interests of the Town of Nantucket Wetlands Protection Bylaw.

- Vernal pool habitats, regardless of whether the site has been certified by the Massachusetts Natural Heritage and Endangered Species Program, are defined as confined basin depressions which, at least most years, hold water for a minimum of two continuous months during the spring and/or summer, and which are free of adult fish populations. Areas within 100 feet of the mean annual boundaries of such depressions, to the extent that such habitat is within an Area Subject to Protection under the Town of Nantucket Wetlands Protection Bylaw as specified in Section 136-3 are deemed essential breeding habitat, and provide other extremely important habitat functions during non-breeding season as well, for a variety of amphibian species, and are important habitat for other wildlife species, and shall be considered significant to the interests of the Town of Nantucket Wetlands Protection Bylaw. The Commission must determine, in the case that a vernal pool has not been certified by the Massachusetts Natural Heritage and Endangered Species Program, that it has successfully been identified as eligible for certification by its consultants or a professional wildlife biologist or other expert.

Habitable Space - space in a structure for living, sleeping, eating, or cooking. Bathrooms, toilet compartments, closets, halls, storage or utility space, and similar areas are not considered habitable space.

Interests Protected by the Bylaw - the wetland values either singly or collectively specified

in Section 136-2 of the Bylaw.

Lake - any open body of fresh or salt water, either naturally occurring or man-made by impoundment, which is never without standing water due to natural causes except during periods of extended drought, and the land under the water body. Basins or lagoons which are part of waste water treatment plants shall not be considered ponds, nor shall swimming pools, man-made water bodies that are not hydrologically connected to adjacent water bodies, groundwater (including perched groundwater), or other impervious man-made retention basins.

Land Subject to Coastal Storm Flowage - land subject to any inundation caused by coastal storms up to and including that caused by the 100-year storm, surge of record, or storm of record, whichever is greater.

Land Subject to Flooding - an area of low, flat topography, or a depression or basin either 1) hydrologically directly connected with a water body, extending from the banks or the upland edge of the vegetated wetlands surrounding this water body, or 2) an isolated depression or basin which on the average at least every five years confines standing water over an area of at least 1,000 square feet as observed under conditions of average rainfall. The boundary of Land Subject to Flooding which is hydrologically connected to a water body is the estimated lateral extent of the flooding, which shall be based on the 100-year storm event during a year of average rainfall, or by actual record if that is higher. Constructed drainage facilities and/or swales will not be considered as land subject to flooding for the purposes of the Nantucket Wetlands Protection Bylaw.

Marsh (Freshwater) - areas where a plant community exists in standing or running water during the growing season, and/or where depth to high groundwater is within 18" of the surface and/or where soils exhibit hydric characteristics, and where a significant part of the plant community is composed of, but not limited to nor necessarily including all, the following plants or groups of plants: arums (Araceae), bladder worts (Utricularia), bur reeds (Sparganiaceae), button bush (Cephlanthus occidentalis), cattails (Typha), duck weeds (Lemnaceae), eelgrass (Vallisneria), frog bits (Hydrocharitaceae), horsetails (Equisetaceae), hydrophilic grasses (Graminae), leatherleaf (Chamaedaphne calyculata), pickerel weeds (Pontederiaceae), pipeworts (Eriocaulon), pond weeds (Pontederiaceae), rushes (Juncaceae), sedges (Cyperaceae), smartweeds (Polygonum), sweet gale (Myrica gale), water milfoil (Haloragaceae), water lilies (Nympheacea), water starworts (Callitrichaceae), or water willow (Decodon verticillatus).

Marsh (Saltwater) - a coastal wetland that extends from the ocean landward up to the highest spring tide line, where soils exhibit hydric characteristics, and where a significant part of the plant community is composed of, but not limited to nor necessarily including all, the following plants or groups of plants: salt meadow cord grass (Spartina patens), salt marsh cord grass (Spartina alterniflora), spike grass (Distichlis spicata), sea lavender (Limonium nashii), seaside plantagao (Plantagao juncoides), aster (Aster subulatus), sea-blite (Suaeda maritima), black-grass (Juncus gerardi), samphire (Salicornia europaea), glasswort (S. begelovii), reed (Phragmites communis), saltmarsh bulrush (Scirpus robustus), or cattails (Typha spp.).

Meadows (wet) - areas where ground water is at the surface for a significant part of the growing season, and/or where depth to high ground water is within 18" of the surface, and/or where soils exhibit hydric characteristics including mottling within 18" of the ground surface, and where a significant part of the plant community is composed of various grasses, sedges, and rushes, made up of, but not limited to nor necessarily including all of the following plants or groups of plants: blue flag (Iris), vervain (Verbena), thoroughwort (Eupatorium), dock (Rumex), false loosestrife (Ludwigia), hydrophilic grasses (Graminae), loosestrife (Lythrum), marsh fern (Dryopterus thelypteris), rushes (Juncacea), sedges (Cyperaceae), sensitive fern (Onoclea sensibilis), smartweed (Polygonum), or jewelweed (Impatiens capensis).

MEPA - the Massachusetts Environmental Policy Act, M.G.L. c. 30, ss. 62-62H and regulations promulgated pursuant thereto, 301 CMR 10.00, *et seq*.

Minimize (no significant impact) - to achieve the least amount of adverse impact that can be attained through siting or using best available measures or best practical measures, as deemed appropriate by the Commission.

Nantucket Notice of Intent (NNOI) - the written application filed by any person intending to alter a Area Subject to Protection Under the Nantucket Wetlands Bylaw, as described in Section 136-3C of the Bylaw.

Nantucket Request for Determination of Applicability (NRDA) - the written request filed by any person seeking the Commission's determination as to whether the Bylaw applies to any area or work thereon.

Notice of Intent - the written notice filed by any person intending to alter an Area Subject to Protection under the Massachusetts Wetlands Protection Act, M.G.L. c. 131 s. 40.

Permit - the document issued by the Commission containing conditions that regulate or prohibit an activity under the Bylaw.

Person - includes any individual, group of individuals, association, partnership, corporation, company, business organization, trust, estate, the commonwealth or political subdivision thereof to the extent subject to Town bylaws, administrative agencies, public or quasi-public corporations or bodies, the Town of Nantucket and any other legal entity, its legal representatives, agents or assigns.

Pier – any structure, floating or fixed, attached or adjacent to land, and placed in or and extending into coastal inland waters (in the case of tidal waters, seaward of the mean high tide line) which is designed, or is suitable for use, for access to vessels, or for swimming or any other similar recreational, commercial, or educational purpose.

Pollution - contamination of land, or surface or ground water with materials not normally

present in those waters, or with elevated levels of naturally occurring materials.

Pond, Fresh or Salt - any open body of ~~fresh or salt~~ water, either naturally occurring or man-made by impoundment, which is never without standing water due to natural causes except during periods of extended drought, and the land under the water body. Basins or lagoons which are part of waste water treatment plants shall not be considered ponds, nor shall swimming pools, man-made water bodies that are not hydrologically connected to adjacent water bodies, groundwater (including perched groundwater), or other impervious man-made retention basins.

Private Water Supply - any source or volume of surface or ground water to be in private use or demonstrated to have a potential for private use, including drinking water supply, irrigation, or for fire protection.

Project - a proposal to do work, or the performance of such work; an undertaking.

Public Water Supply - any source or volume of surface or ground water demonstrated to be in public use for drinking water or fire protection, or approved for water supply pursuant to M.G.L. c. 111, s. 160 by the Division of Water Supply of the DEP, or demonstrated to have a potential for public use as a drinking water supply or for fire protection.

Recreation - activities of individuals done for relaxation carried out in resource areas of this Bylaw which include but are not limited to swimming, picnicking, walking, hunting, fishing, and boating.

Remove - to take away any type of material including vegetation, or thereby change an elevation, either temporarily or permanently.

River - any natural flowing body of water that empties to any ocean, lake, pond, or other river, and which flows throughout the year.

Shellfish – aquatic mollusks and crustraceans: bay scallop (Argopecten irradians), blue mussel (Mytilus edulis), ocean quahog (Arctica islandica), American oyster (Crassostrea virginica), quahog (Mercenarai merceneria), razor clam (Ensis directus), surf clam (Spisola soldissma), sea scallop (Placopecten magellamicus), soft shell clam (Mya arenaria), lobster (Homarus americanus), and blue crabs (Callinectes sapidus), knobbed whelk (Busycon carica), waved whelk (Buccinum undatum), and channel whelk (Busycon canaliculatum). The term shellfish also shall include horsehoe crab (Limulus polyphemus).

Soil temperature – the temperature of the soil four inches below the surface grade as taken by a soil thermometer.

Storm Damage Prevention - the prevention of damage caused by water from storms, including but not limited to: erosion and sedimentation; damage to vegetation, property, or

buildings; or damage caused by flooding, waterborne debris, or waterborne ice.

Stream - a body of running water, and the land under the water, which includes brooks, creeks, and man-made water courses, which moves in a defined channel or swale due to hydraulic gradient. A stream may be intermittent, that is, it does not flow throughout the year.

Structure - a combination of materials assembled at a fixed location to give support or shelter such as a building, framework, retaining wall, platform, bin, radio antenna mast, or the like. The term structure may also be applied to appurtenances that are constructed of impervious surfaces, such as but not limited to swimming pools, recreational playing courts, roads, parking areas, parking lots, driveways, etc. Drainage basins, split rail fences, septic tanks, subsurface propane tanks, and signs are not structures. The word "structure" shall be construed, where the context requires, as though followed by the words "or part or parts thereof."

Structure, Coastal Engineering - any structure intended, or constructed so as, to prevent or alleviate storm damage, or modify tidal action, wave action, littoral flow, or erosion. Examples of these structure may include but are not limited to any bulkhead, revetment, seawall, rip-rap, groin, jetty, artificial seaweed, geotextile fabric, plastic sheeting, multiple rows of fencing or other as determined by the Commission.

Substantially Improved - cumulative expansion of habitable space greater than twenty percent (20%).

Swamps - areas where depth to high groundwater is within 18” of the surface, and/or where runoff water from surface drainage frequently collects above the soil surface, and/or where soils exhibit hydric characteristics, and where a significant portion of the plant community is made up of, but not limited to nor necessarily including all, the following plants or groups of plants: alders (Alnus), ashes (Fraxinus), azaleas (Rhododendron Canadense and R. viscosum), black alder (Ilex verticillata), button bush (Cephalanthus occidentalis), highbush blueberry (Vaccinium corymbosum), poison sumac (Toxicodendron vernix), red maple (Acer rubrum), sphagnum mosses (Sphagnum), black gum tupelo (Nyssa sylvatica), sweet pepper bush (Clethra alnifolia), willow (Salicaceae), and common reed (Phragmites communis).

Water Dependent Uses - projects which require direct water access for their intended use and therefore cannot be located out of the Area Subject to Protection under the Bylaw. Examples include but are not limited to: docks, piers, boat landings, boathouses, marinas, stairs to beaches, and boardwalks over wetland vegetation. Projects which benefit from wetlands access but which do not require it are not water dependent uses. Examples include: restaurants, dwellings, and commercial enterprises servicing marine-related uses such as fish markets, repair facilities, ships' chandleries, and general use recreational trails.

Wetland Scenic Views - those areas which provide important visual linkage for the public with scenic wetlands that are vistas typical of and serve to define the unique Nantucket environment. Scenic wetlands include but are not limited to the following features: expansive open space, significant habitat areas, large areas of natural features, placement and sizing of both natural and man-made features, or mix of colors and textures created by interactions among water, sand, and different types of vegetation. Visual linkage for the public is not restricted to views from public ways, but also encompasses views from areas used by the public, such as private and public conservation land, dirt "moor" roads, major private ways intensively used by the public, great ponds, beaches, banks (eroding and noneroding, coastal and inland), Nantucket's harbors, and the ocean.

Wildlife - all non-domesticated mammals, birds, reptiles, amphibians, fishes, or invertebrates, which are dependent upon a wetland resource defined by the Bylaw for any part of their life cycle. Special consideration shall only be given to members of the class Insecta if they are rare or endangered as defined by the Massachusetts Natural Heritage Program or its successor, or if they are a major food source of other wildlife, but not if the insect species is determined by the Commission and/or the Board of Health to constitute a pest whose protection under the Bylaw would be a health risk to humans at the proposed project site.

Work - all activities set forth in the Bylaw, Section 136-3A, including altering, removing, filling, dredging, or building upon.

1.03 PROCEDURES

A. Where the Bylaw states that the Commission is to receive a request or notice, such request or notice shall be given in writing to the Commission office, or in the case of emergency, the request can be made directly to the Commission's chairperson.

B. NANTUCKET NOTICE OF INTENT (NNOI)

1. Any person who proposes to remove, fill, dredge, alter, or build upon any area subject to protection under the bylaw, or within 25 or 50 feet of any area subject to protection (as deemed necessary), shall submit a Nantucket Notice of Intent (NNOI) and other application materials in accordance with the submittal requirements set forth on the NNOI form. Such submission shall not be required for use and normal maintenance as

defined under “Grandfathering/Pre-existing use” in Section 1.02, “Definitions,” above.

2. The Commission may accept plans filed with a Notice of Intent under the Wetlands Protection Act, M.G.L. c.131 s.40, as plans under this Bylaw. The NNOI shall be filed concurrently with a Notice of Intent under the Wetlands Protection Act. This provision shall also apply to any Amended Order of Conditions request, Abbreviated Notice of Resource Area Delineation or Request for Determination of Applicability.

3. When a person filing an application is other than the owner, the findings and decision of the Commission shall be sent by the Commission to the owner as well as to the person filing the application, and the applicant shall supply the Commission with the name and current address of the owner.

4. The Commission shall give the NNOI the same file number as the accompanying Notice of Intent from the D.E.P when joint filings under MGLCh131s40 (the State Wetlands Protection Act) and Chapter 136 (the Town of Nantucket Wetlands Protection Bylaw) are made. The Commission shall follow this provision to include Amended Orders of Conditions, Abbreviated Notice of Resource Area Delineation and Request for Determination of Applicability. When a filing is only required under the provisions of the Town of Nantucket Wetlands Protection Bylaw a separate bylaw file number will be assigned.

5. In the event that only part of the work proposed lies within an Area Subject to Protection under the Bylaw, all aspects of the work shall be briefly described on the NNOI form. Only those work components that lie within areas subject to jurisdiction shall be conditioned.

C. PUBLIC HEARINGS BY CONSERVATION COMMISSION

1. The Commission in an appropriate case may combine its hearing under the Bylaw with the hearing conducted under the Wetlands Protection Act, M.G.L. 131, s. 40.

2. When a person filing a NNOI is not the owner, notice of the time and place of a hearing shall be given to the owner, by the Commission at the address supplied to the Commission by the applicant.

3. Any changes in the plans or the proposed work made by the applicant during the course of the public hearings, shall be made in writing and shall be filed by the applicant with the Commission. Such changes must be filed prior to the close of the public hearing on that NNOI, unless otherwise specified by the Commission during a public hearing.

D. EXTENSIONS OF PERMITS

1. The Commission may extend a Permit as provided by the Bylaw Section 136-4B.

2. All requests for an extension shall be in writing.

3. The Commission shall not deny a request for an extension unless it finds by a preponderance of the evidence any one of the following:

   a) No work has begun on the project; unless the failure to begin work is due to an unavoidable delay in obtaining other necessary state or municipal approvals, permits, or variances, such as in the event other approvals, permits, or variances are appealed;

   b) New information, not available at the time the Permit was issued, indicates that the Permit is not adequate to protect the interests identified in the Bylaw;

   c) Incomplete work is causing damage to the interests identified in the Bylaw;

   d) Work has been done in violation of the Bylaw, these regulations, or conditions in the Permit; or

   e) The extension request is not timely. An extension request shall be timely if received by the Commission a minimum of 30 days prior to the expiration of the Permit.

4. If issued, an Extension Permit shall be signed by a majority of the Commission.

E. NANTUCKET CERTIFICATES OF COMPLIANCE

1. Upon Written request by the applicant, a Nantucket Certificate of Compliance may be issued by the Commission which shall certify that the conditions required by the Permit as of the date of the application for a Nantucket Certificate of Compliance have been completed in compliance with the Permit. If issued by the Commission, the Certificate of Compliance shall be signed by a majority of the Commission.

2. If a project has been completed in accordance with plans stamped by a registered professional engineer, architect, landscape architect, or land surveyor, a written statement by such a professional person certifying substantial compliance with the plans and setting forth any deviation that exists from the plans approved in the Order shall accompany the request for a Certificate of Compliance. The required as-built plan shall show all wetland areas, buffer zones, topography, other landscape features relevant to the project and any differences to the approved project.

3. Prior to the issuance of a Certificate of Compliance, the Commission may make a site visit, in the presence of the applicant, or, if the applicant so desires, in the presence of the applicant's agent.

4. Partial Certificates of Compliance will not be issued by the Commission, except for rare and extenuating circumstances. The burden of proof to substantiate these circumstances shall be with the applicant.

F. WAIVERS OF REQUIREMENTS

1. All requests for waivers shall be in writing.

2. The Commission may, in its discretion for good cause shown, grant waivers from the operation of one or more of these regulations pursuant to this section. Such waivers shall be granted only in accordance with the provisions of this section.

3. A waiver shall be granted only for the following reasons and upon the following conditions:

a) The Commission may grant a waiver from these regulations when the Commission finds that, given existing conditions, the proposed project will not adversely impact the interests identified in the Bylaw and there are no reasonable conditions or alternatives that would allow that project to proceed in compliance with the regulations. The burden of proof to show no adverse impact to the interests identified in the Bylaw, Chapter 136 Section 2, shall be the responsibility of the owner/applicant. The burden of proof to show no reasonable alternative shall be the responsibility of the owner/applicant and shall consist of a written alternatives analysis detailing why the proposed project can not otherwise proceed in compliance with the performance standards in these regulations with an explanation of why each is not feasible.

It shall be the responsibility of the applicant to provide the Commission with any information, which the Commission may request in order to enable the Commission to ascertain such adverse effects. The failure of the applicant to furnish any information which has been so requested may result in the denial of a request for a waiver pursuant to this subsection.

b) The Commission may grant a waiver from these regulations when portions of the Buffer Zone between the proposed project and adjacent resource area are previously altered and are not within the control of the project owner/applicant, such as public or semi public pedestrian and vehicular accessways.

c) The Commission may grant a waiver from these regulations when the

Commission finds that a project will provide a long-term net benefit/improvement to the resource area, provided any adverse effects are minimized by carefully considered conditions. However, no such project may be permitted which could have an adverse effect on rare wildlife species.

d) The Commission shall grant a waiver from these regulations when the work proposed is grandfathered and qualifies as a pre-existing use, as defined in Section 1.02 of these Regulations.

4. The Commission may impose additional conditions in granting a permit pursuant to this Section, including imposing limits on project size or effect or requiring other compensatory measures, such as wetland replication.

G. FEES

1. Fees, payable to the Town of Nantucket, must be paid under the provisions of the Bylaw (and in addition to the fees required by M.G.L. c 131s 40) before the pertinent application can be accepted by the Commission.

Request for Determination of Applicability	$25.00
Notice of Intent	$25.00
Certificate of Compliance	$25.00
Extension Permit	$25.00
Minor Modification	$25.00
Amended Order of Conditions	$25.00

2. When the Town or County of Nantucket is the applicant, the fee will be waived.

H. RECORDING OF DOCUMENTS

The following documents issued by the Commission are required to be properly recorded in the Registry of Deeds or the Land Court, within the chain of title of the affected property:

Order of Conditions
Amended Order of Conditions
Extension Permit
Certificate of Compliance

I. ADDITIONAL INFORMATION

1. Additional Information to be provided with Filings

a) In addition to information already required by the Commonwealth of

Massachusetts, the following information is required with each Notice of Intent filed with the Commission:

1. Two sets of Notices of Intents with all supportive plan, maps, and documents

2. Filing costs as separate checks for:

   - Town share of state filing fee
   - Town Bylaw fee
   - Advertising fee
   - Cost and expense of technical consultants

3. Supportive plans, maps and documents shall include at a minimum

   - DEP Wetland Delineation Forms for all vegetated wetland resource areas (two completed forms required to show boundary, one wetland and one upland)
   - Locus map
   - Project plans shall include:
   - Assessor's reference numbers
   - Book and page number of deed or certificate of title number
   - Current certificate of title or deed
   - appropriate FEMA floodplain reference
   - erosion control measures for proposed site work
   - work limit line
   - USDA/NRCS soils map information
   - All wetland and/or habitat restriction information
   - All wetland flagging location numbers placed in field for resource delineation
   - 50-foot and 100-foot setbacks from all wetland resource areas
   - 2-foot interval contours based on mean sea level
   - appropriate professional stamp and signature (engineer, land surveyor, architect, sanitarian, etc.)
   - all other necessary information to describe proposed project including
   - standard plan requirements for title block, scale, direction, etc.

4. Additional information will be required as deemed necessary on a project specific basis in accordance with the general filing requirements established by the Commission for Notices of Intent revised 6/15/94.

b) In addition to information already required by the Commonwealth of Massachusetts, the following information is required with each Request for a Determination of Applicability filed with the Commission:

1. Two sets of RDA with all supportive plans, maps and documents.

2. Filing costs as separate checks for:

   - Town Bylaw fee
   - Advertising fee
   - Cost and expense of technical consultants

3. Supportive plans, maps and documents shall include as a minimum

   - DEP Wetland Delineation Forms for all vegetated wetland resource areas
   - Nantucket Assessor's reference numbers
   - locus map
   - project plans and/or narrative with sufficient information to evaluate wetland resource and buffer zone impact (upon staff review of filing, additional project specific information may be required)

2. Additional Information to be provided before Field Viewings
   On-site requirements to be in place before the field inspection:

   a) DEP Wetland Delineation Forms filed for all vegetated wetland resource areas present on or affecting the project site

   b) Edges of wetland resource areas within 100 feet of proposed work must be flagged and numbered before the field inspection

   c) Corners of proposed structures must be staked (flagged) and clearly labeled before field inspection

   d) Property boundaries must be staked before field inspection

   e) Project representative should be present for field inspection

Failure to have the lot properly staked may result in non-review.
Action on a project by the Commission indicates that the above filing requirements have been met.

1.04 SEVERABILITY AND INVALIDITY

The invalidity of any section of these regulations shall not invalidate any other section or provision, nor shall it invalidate any permit or determination which previously has been issued.

1.05 EFFECTIVE DATE

The effective date of these regulations shall be the date on which these regulations are approved by vote of the Conservation Commission. These regulations shall apply to all NNOI or NRDA's filed after that date.

PART II - REGULATIONS FOR COASTAL WETLANDS

2.01 LAND UNDER THE OCEAN

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to activities involving land under the ocean are necessary and proper for the following reasons:

Land under the ocean provides feeding areas, spawning and nursery grounds, and shelter for many coastal organisms related to marine fisheries and wildlife. Destruction of eelgrass beds (Zostera marina) will harm scallop production. Nearshore areas, and in some cases offshore areas, of land under the ocean help reduce storm damage, erosion, and flooding by diminishing and buffering the high energy effects of storms. Submerged sand bars dissipate wave energy. Such areas provide a source of sediment for seasonal rebuilding of coastal beaches and dunes. The bottom topography and sediment type of nearshore areas of land under the ocean is critical to erosion control, storm damage protection, and flood control. Water circulation and flushing rates, distribution of grain size, water quality (including but not limited to turbidity, temperature, nutrients, pollutants, salinity, and dissolved oxygen), and the habitat of wildlife, finfish, and shellfish are all factors critical to the protection of significant wildlife habitat and marine fin and shell fisheries. Land under the ocean in an unobstructed state is important to recreational swimming, fishing, and shellfishing, to recreational boating and sailing, to commercial fishing and shellfishing, and to wetland scenic views.

2. In view of the foregoing, whenever a proposed project involves removing, filling, dredging, altering or building upon land under the ocean, the Commission shall find that such land is significant to the protection of the following interests: flood control, erosion control, storm damage prevention, fisheries, shellfish, wildlife, significant wildlife habitat, recreation, and wetland scenic views. These findings may be overcome only upon a clear showing that the Land Under the Ocean does not play a role in protecting any of the interests given above and only upon a specific written determination to that effect by the Commission.

B. PERFORMANCE STANDARDS

Land Under the Ocean shall be presumed significant to an Interest protected by the Bylaw

as referenced in Section A, therefore the following regulations apply:

1. Dredging shall be designed and carried out using the best available measures as determined by the Commission so as to have the least possible adverse effects or changes in marine productivity caused by changes in, or resulting from suspension or transport of pollutants, sediment transport, smothering of bottom organisms, accumulation of pollutants by organisms, destruction of habitat or nutrient source areas, or changes in water circulation and water quality.

2. All dredging shall use best available measures to minimize adverse effects caused by changes in bottom topography resulting in an increase in height and velocity of waves hitting the shore, localized changes in circulation patterns or in changes in sediment transport which affect natural replenishment of beaches or maintenance of channels.

3. Residential piers shall be constructed so as not to change shoreline movement of sediment, harm shellfish resources, obstruct commercial shellfishing, or obstruct the reserved public rights of fishing, fowling, navigation, or passage. Residential piers shall not displace public moorings without written approval from the Harbormaster. No solid fill piers shall be permitted.

4. Construction of commercial piers shall be in compliance with the Town of Nantucket Zoning Bylaws and shall not affect sediment transport, and shall not destroy or pollute fisheries and shellfish habitat or nutrient source areas for those resources. No solid fill piers shall be permitted.

5. Best available measures as determined by the Commission shall be used to minimize adverse effects of a commercial or residential pier on the interests protected by the Bylaw.

6. Aquaculture projects shall be undertaken pursuant to such means as may be established by the Commission so as to have the least possible adverse effect on wildlife, erosion control, storm damage prevention, flood control, recreation or public access. No destruction of habitat or areas where shellfish feed, or change in water quality or circulation in any manner which adversely affects productivity of marine fisheries or shellfish beds shall be permitted.

7. No new bulkheads or coastal engineering structures shall be permitted to protect structures constructed or substantially improved after 8/78. Bulkheads may be rebuilt only if the Commission determines there is no environmentally better way to control an erosion problem, including in appropriate cases the moving of the threatened building. Other coastal engineering structures may be permitted only upon a clear showing that no other alternative exists to protect a structure built prior to 9/78, but not substantially improved, from imminent danger.

8. Water dependant projects shall be designed and performed so as to cause no adverse effects on wildlife, erosion control, marine fisheries, shellfish beds, storm damage prevention, flood control, recreation, and aquatic vegetation.

9. No activity on land under the ocean which is not water dependant shall be permitted by the Commission, except activity allowed pursuant to a waiver from these regulations, as set forth in Section 1.03F.

10. The Commission may impose such additional requirements as are necessary to protect the Interests Protected by the Bylaw.

2.02 COASTAL BEACHES (and TIDAL FLATS)

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to activities involving coastal beaches and tidal flats are necessary and proper for the following reasons:

Coastal beaches and tidal flats aid in storm damage prevention, erosion and flood control; serve as a source of sediment for downdrift coastal resource areas; serve to provide wildlife habitat to rare, endangered, and otherwise significant wildlife, serve to protect and provide habitat for marine fisheries and shellfish; and serve to provide important wetland scenic views and recreation. Coastal beaches dissipate wave energy by their gentle slope, their permeability, and their granular nature which permit changes in beach form in response to changes in wave conditions. Coastal beaches serve as a sediment source for dunes and subtidal areas. Steep storm waves cause beach sediment to move offshore, resulting in a gentler beach slope and greater energy dissipation. Less steep waves cause an onshore return of beach sediment, where it will be available to provide protection against future storm waves. A coastal beach at any point serves as a sediment source for coastal areas downdrift from that point. The oblique approach of waves moves beach sediment alongshore in the general direction of wave action. Thus the coastal beach is a body of sediment which is moving along the shore. Coastal beaches serve the purpose of storm damage prevention, erosion control, and flood control by dissipating wave energy, by reducing the height of storm waves, and by providing sediment to supply other coastal features, including coastal dunes, land under the ocean, and other coastal beaches. Interruptions of these natural processes by man-made structures and/or activities reduce the ability of the coastal beach to perform these functions. Tidal flats are important to the protection of marine fisheries because they provide habitats for marine organisms, such as polychaete worms and mollusks, which in turn are food sources for fish. Tidal flats are also sites where organic and inorganic materials are entrapped and then returned to the photosynthetic zone of the water column to support algae and other primary producers of the marine food web. Coastal beaches and flats serve as important habitats for a wide variety of wildlife, including but not limited to coastal birds, turtles, shellfish and finfish.

They are used in particular by coastal birds for feeding areas and nesting sites. The natural erosional and depositional cycles, sediment grain size, water quality (including but not limited to turbidity, temperature, nutrients, pollutants, salinity, and dissolved oxygen) and circulation, and elevation of the land surface are all features of wildlife habitat which are critical characteristics for the protection of wildlife. Characteristics of coastal beaches and flats which are critical to the protection of marine fisheries, and shellfish and their habitat include: distribution of sediment grain size, movement of sediment, water quality (including the characteristics given above) and circulation, and beach relief and elevation. Characteristics of coastal beaches and flats which are critical to storm damage prevention, erosion control, or flood control include sediment volume and form, their ability to respond to wave action, natural erosional and depositional cycles, and wave intensities. Characteristics of coastal beaches and flats which are critical to recreation are topography, sediment grain size, water quality (including the characteristics given above), water circulation rates and patterns, unobstructed access along shore, natural erosional and depositional cycles, and wave intensity. Characteristics of coastal beaches which are critical to wetland scenic views are natural erosion and deposition cycles, relief and elevation, sense of openness, and solitude. Land within 100 feet of a coastal beach or tidal flat is considered to be important to the protection and maintenance of coastal beaches and tidal flats, and therefore to the protection of the wetland values which these areas contain.

2. In view of the foregoing, whenever a proposed project involves removing, filling, dredging, altering, or building upon a coastal beach or flat, the Commission shall find that the beach or flat is significant to the protection of the following interests: flood control, erosion control, storm damage prevention, fisheries, shellfish, wildlife, recreation, and wetland scenic views. These findings may be overcome only upon a clear showing that the beach or flat does not play a role in protecting any of the interests given above and upon only a specific written determination to that effect by the Commission.

B. PERFORMANCE STANDARDS

A Coastal Beach, Tidal Flat or Land within 100 feet of a Coastal Beach or Tidal Flat shall be presumed significant to the Interests Protected by the Bylaw, as referenced in Section A, therefore the following regulations shall apply.

1. The provisions of Section 2.01B (1-8) (Land Under the Ocean) shall apply to coastal beaches and tidal flats.

2. No new bulkheads or coastal engineering structures shall be permitted to protect structures constructed, or substantially improved, after 8/78. Bulkheads may be rebuilt only if the Commission determines there is no environmentally better way to control an erosion problem, including in appropriate cases the moving of the threatened building. Other coastal engineering structures may be permitted only upon a clear showing that no other alternative exists to protect a structure built prior to 9/78, and

not substantially improved, from imminent danger.

3. Dredging projects in flats must be done in accordance with such procedures as the Commission determines would disturb the absolute minimum amount of habitat possible for both the borrow site and the area in which spoils are placed.

4. Clean fill of compatible grain size may be used on a Coastal Beach but not on a Tidal Flat, only if the Commission authorizes its use, and only if such fill is to be used for a beach or dune nourishment project. All possible mitigation measures shall be taken, as determined by the Commission, to limit the adverse effects of the fill.

5. No part of any septic system shall be placed in shifting sands or on a coastal beach. The septic leach facility shall be at least 100 feet from the spring high tide line.

6. All work on projects which-are not water dependent shall maintain at least a 25-foot natural undisturbed area adjacent to a coastal beach. All structures which are not water dependent shall be at least 50 feet from a coastal beach.

7. In areas of eroding shoreline, the distance from all buildings to the coastal beach shall be at least 20 times the average annual shoreline erosion or 100 feet, whichever is the lesser. The average annual shoreline erosion rate shall be determined by averaging the annual erosion rate over a 150 year period ending the date the NNOI was filed, or if no NNOI was filed, the date construction began. If erosion data is not available for the 150-year period, the Commission shall determine the average annual erosion rate from such lesser time period for which erosion data is available. In cases where documentation can be provided to show that the use of the 150-year period is inappropriate to existing shoreline characteristics and trends, alternate shoreline change rates may be used when based on a preponderance of credible evidence.

8. Vehicular access for existing houses or for recreational use shall be as unpaved ways and shall be done in accordance with such procedures as the Commission determines will minimize any adverse effect on the beach and the Interests of the Bylaw.

9. Fertilizers shall be used in accordance with the “Best Management Practices for Landscape Fertilizer Use on Nantucket Island” (a copy of which is attached to these regulations as appendix A).

10. The Commission may impose such additional requirements as are necessary to protect the Interests Protected by the Bylaw.

2.03 COASTAL DUNES

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to activities involving coastal dunes are necessary and proper for the following reasons:

Coastal dunes, including coastal dune fields, aid in storm damage prevention, erosion and flood control; protect land in coastal areas from storm damage and flooding; serve as a sediment source for beach and intertidal areas; serve to provide wildlife habitat to rare, endangered, and otherwise significant wildlife; and serve to provide important wetland scenic views and recreation. Coastal dunes aid in storm damage prevention, erosion control, and flood control by supplying sand to coastal beaches. Coastal Dunes do not significantly inhibit transport of pollutants into groundwater. Coastal dunes protect inland coastal areas from storm damage and flooding by storm waves and elevated sea levels because such dunes are higher than the coastal beaches which they border. Vegetated cover contributes to the growth and stability of coastal dunes by providing conditions favorable to sand deposition. On retreating shorelines, the ability of coastal dunes bordering a coastal beach to move landward at a rate of shoreline retreat allows these dunes to maintain their form and volume. Characteristics of coastal dunes which are critical for storm damage prevention, flood control, and erosion control include: ability of dune to erode and change in response to coastal beach conditions; dune volume, sediment grain size, and slope; dune form which can change with wind and natural water flow; amount, continuity, and density of vegetative cover; wildlife habitat and ability of dune to move landward and laterally. Coastal dunes are important habitats for a wide variety of wildlife, particularly turtles and birds for feeding and nesting areas. Amount of vegetation, dune height and slope, sediment grain size, and degree of isolation from human-caused disturbances are all features of dunes which are critical characteristics for the protection of wildlife. Characteristics of coastal dunes which are critical to wetland scenic views are dune form, slope, elevation, size of dunefield, proportion and scale of dunes in relationship with other land forms. Land within 100 feet of a coastal dune is considered to be significant to the protection and maintenance of coastal dunes, and therefore to the protection of the wetland values which these areas contain.

2. In view of the foregoing, whenever a proposed project involves removing, filling, dredging, altering or building upon a coastal dune, the Commission shall find that the dune is significant to the protection of the following interests: flood control, erosion control, storm damage prevention, prevention of pollution, wildlife, and wetland scenic views. These findings may be overcome only upon a clear showing that the dune does not play a role in protecting any of the interests given above and only upon a specific written determination to that effect by the Commission.

B. PERFORMANCE STANDARDS

A Coastal dune, coastal dune field, or land within 100 Feet of a coastal dune or coastal dune field, shall be presumed significant to the Interests Protected by the Bylaw as referenced in Section A, therefore the following regulations shall apply.

1. No coastal revetments or coastal engineering structures of any type shall be constructed, rebuilt, or repaired.

2. All projects which are not water dependent shall maintain at least a 25-foot natural undisturbed area adjacent to a coastal dune. All structures which are not water dependant shall be at least 50 feet from a coastal dune.

3. No excavation or disturbance of vegetative cover shall be allowed on a coastal dune unless the area is completely restored, replanted, and stabilized to its original form and volume.

4. Fill may be used only if the Commission authorizes its use and only if such fill is to be used for beach and dune nourishment projects.

5. No part of any septic system shall be placed in shifting sands or on or in a coastal dune. The septic leach facility shall be at least 100 feet from the upland edge of a coastal dune or coastal dune field.

6. Any activity allowed on a coastal dune or within 100 feet of a dune shall be restricted to such activity that is determined by the Commission not to have any adverse effect on the dune by altering the ability of wind or waves to remove sand from or deposit sand on a dune; by disturbing vegetative cover in a manner sufficient to destabilize the dune; by causing any modification of the dune form and slope which would increase the potential for erosion, storm or flood damage; by interfering with landward or lateral movement of the dune; or by causing the rate of sand removal to increase through man-made means or structures.

7. No activity shall be permitted, other than the maintenance and repair of a structure existing on the effective date of these regulations, that will result in construction of a building upon a coastal dune or within 50 feet of any coastal dune.

8. Any pedestrian or elevated walkway must be designed as determined by the Commission so as to minimize disturbances of vegetative cover.

9. Fertilizers shall be used in accordance with the “Best Management Practices for Landscape Fertilizer Use on Nantucket Island” (a copy of which is attached to these regulations as appendix A).

10. Vehicular access for existing homes or recreational use shall be as unpaved ways and shall be done in accordance with such procedures as the Commission determines will

minimize any adverse effect on the dune and the Interests of the Bylaw.

11. The Commission may impose such additional requirements as are necessary to protect the Interests Protected by the Bylaw.

2.04 BARRIER BEACHES

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to activities involving barrier beaches are necessary and proper for the following reasons:

Barrier beaches are composed of tidal flats, beaches, and dunes. As such, barrier beaches perform the same functions and are critical to the same interests as referenced in Sections 2.02 and 2.03 of these Bylaw Regulations and therefore these provisions shall also apply to barrier beaches. Barrier beaches protect landward areas from flooding and erosion because they provide a buffer to storm waves and to sea levels elevated by storms. Barrier beaches protect from wave action such highly productive areas as dunes, tidal flats, salt marshes, estuaries, lagoons, harbors, salt ponds, and freshwater marshes and ponds, which are in turn important to fisheries, shellfish and wildlife habitat. Barrier beaches are maintained by the alongshore movement of beach sediment caused by wave action. The coastal dunes, beaches, and tidal flats of a barrier beach are made up of sediment supplied by wind action, storm wave overwash, and tidal inlet deposition. Barrier beaches in Massachusetts undergo a landward or alongshore migration caused by the landward and alongshore movement of sediment by wind, storm waves, and tidal current processes. The continuation of these processes maintains the volume of the landform which is necessary to carry out its storm and flood buffer functions. The ability of barrier beaches to respond to wave action, including storm overwash sediment transport, is critical to the protection of wetlands values of barrier beaches.

2. In view of the foregoing, whenever a proposed project involves removing, filling, dredging, altering or building upon a barrier beach, the Commission shall find that the barrier beach is significant to the protection of the following interests: flood control, erosion control, water pollution, storm damage prevention, fisheries, shellfish, wildlife habitat, recreation, and wetland scenic views. Barrier beaches shall be found significant to private water supply and groundwater if there are existing houses with wells on or near the barrier beach or if the barrier beach abuts, creates, or protects a swamp, freshwater marsh, or pond. These findings may be overcome only upon a clear showing that the barrier beach does not play a role in protecting any of these interests given above and only upon specific written determination to that effect by the Commission.

B. PERFORMANCE STANDARDS

A Barrier Beach or Land within 100 feet of a Barrier Beach shall be presumed significant to the Interests Protected by the Bylaw as referenced in Section A, therefore the following regulations shall apply.

1. No coastal revetments or coastal engineering structures of any type shall be constructed, rebuilt, or repaired.

2. Fill may be used only if the Commission authorizes its use and only if such fill is to be used for beach or dune nourishment projects.

3. No septic system or buildings shall be constructed on a barrier beach. Buildings which pre-exist these regulations may be maintained and repaired. Existing septic systems may be maintained, repaired and upgraded to the best available technology. No expansion of septic systems shall be permitted.

4. Excavation of sand around existing houses may be permitted, but no new projects shall be permitted which will require periodic sand removal for maintenance. All disturbed areas (including blowouts) shall be stabilized through planting of vegetation. The evacuated sand must be retained in the area and be part of the barrier beach.

5. Vehicular access for existing houses or for recreational use shall be unpaved roads and shall be done in accordance with such procedures as the Commission determines will minimize any adverse effect on the barrier beach.

6. No excavation or disturbance of vegetation shall be permitted on a barrier beach unless the area is completely restored, replanted, and stabilized to its original form and volume.

7. Fertilizers shall be used in accordance with the “Best Management Practices for Landscape Fertilizer Use on Nantucket Island” (a copy of which is attached to these regulations as appendix A).

8. The Commission may impose such additional requirements as are necessary to protect the Interests Protected by the Bylaw.

2.05 COASTAL BANKS

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to activities involving coastal banks are necessary and proper for the following reasons:

Coastal banks may serve as a source of sediment for other coastal landforms including beaches, dunes, tidal flats, barrier beaches, and land under the ocean; act as a vertical buffer which protects upland areas from storm damage, erosion, and flooding; provide wildlife habitat to common as well as rare, endangered, and otherwise significant wildlife; and serve to provide important wetland scenic views. Coastal banks composed of unconsolidated sediment and exposed to wave action serve as a major source of sediment for other coastal landforms, including beaches, dunes, and barrier beaches. The supply of sediment is removed from banks by wave action. It is a naturally occurring process necessary to the continued existence of coastal beaches, coastal dunes, and barrier beaches. These areas dissipate storm wave energy, thus protecting structures and coastal wetlands landward of them from storm damage, erosion, and flooding. Coastal banks, because of their height and stability, may act as a buffer or natural wall, which protects upland areas from storm damage, erosion, and flooding. While erosion caused by wave action is an integral part of shoreline processes and furnishes important sediment to downdrift landforms, erosion of a coastal bank by wind and rain runoff, which plays a minor role in beach nourishment, should not be increased unnecessarily. Disturbances to a coastal bank which reduce its natural resistance to wind and rain erosion cause cuts and gullies in the bank, and decrease it value as a buffer. Vegetation tends to stabilize a coastal bank and reduce the rate of erosion due to wind and rain runoff. Vegetated banks are critical to reducing wind and rain erosion and for providing important habitat and biodiversity. A particular coastal bank may serve both as a sediment source and as a buffer or it may serve only one role. Coastal banks provide habitat for wildlife, particularly nesting birds. Characteristics of coastal banks which are critical to wildlife are bank steepness, height, stability, soil size and compaction, and vegetative cover and diversity. Characteristics of coastal banks that are critical to wetland scenic views are bank form, slope, elevation, proportion and scale in relationship to other landforms, vegetative characteristics and diversity, wildlife and habitat, and a sense of presence and solitude. All coastal banks are defined as primary coastal banks for the purposes of Town of Nantucket Bylaws.

2. In view of the foregoing, whenever a proposed project involves removing, filling, dredging, altering, or building upon a coastal bank, the Commission shall find that the bank is significant to the protection of the following interests: flood control, erosion control, storm damage prevention, wetland scenic views, and wildlife. These findings may be overcome only upon a clear showing that the coastal bank does not play a role in protecting any of the interests given above and only upon a specific written determination to that effect by the Commission.

B. PERFORMANCE STANDARDS

Coastal Banks or Land within 100 feet of a Coastal Bank shall be presumed significant to the Interests Protected by the Bylaw as referenced in Section A, therefore the following regulations shall apply.

1. No new bulkheads, coastal revetments, groins, or other coastal engineering structures shall be permitted to protect structures constructed, or substantially improved, after 8/78 except for public infrastructures. Bulkheads and groins may be rebuilt only if the Commission determines there is no environmentally better way to control an erosion problem, including in appropriate cases the moving of the threatened buildings and/or public infrastructure. Other coastal engineering structures may be permitted only upon a clear showing that no other alternative exists to protect a structure that has not been substantially improved or public infrastructure built prior to 9/78, from imminent danger.

2. Piers shall be constructed in compliance with the Town of Nantucket Zoning Bylaws using procedures determined by the Commission to be the best available measures to minimize adverse effects on Interests Protected by the Bylaw.

3. All projects shall be restricted to activity as determined by the Commission to have no adverse effect on bank height, bank stability, wildlife habitat, vegetation, wetland scenic view, or the use of a bank as a sediment source.

4. Elevated walkways designed not to affect bank vegetation shall be required for pedestrian passage over a bank.

5. All projects which are not water dependent shall maintain at least a 25-foot natural undisturbed area adjacent to a coastal bank. All structures which are not water dependant shall be at least 50 feet from a coastal bank.

6. The septic leach facility of a septic system shall be constructed at least 100 feet from the top of the coastal bank and shall not be located within the face of the coastal bank.

7. In areas of an eroding coastal bank, the distance from all new structures to the coastal bank shall be at least 20 times the average annual erosion rate or 100 feet, whichever is the lesser. The average annual erosion rate shall be determined by averaging the annual erosion over a 150-year period ending with the date the NOI was filed, or if no NOI was filed, the date construction began. If erosion data is not available for the 150-year period, the Commission shall determine the average annual erosion rate from such lesser time for which erosion data is available. In cases where documentation can be provided to show that the use of the 150-year period is inappropriate to existing coastal shoreline characteristics and trends, alternate shoreline change rates may be used with the approval of the Commission.

8. All permits issued for the substantial improvement of an existing building or new construction of buildings under the Bylaw within 100 feet landward of the top of a coastal bank shall contain the specific condition that no coastal engineering structure of any kind shall be permitted on an eroding bank in the future to protect the project allowed by this permit, except those coastal engineering structures allowed by a waiver issued pursuant to Section 1.03F of these regulations.

9. The Commission may impose such additional requirements as are necessary to protect the Interests Protected by the Bylaw.

2.06 SALT MARSHES

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to activities involving salt marshes are necessary and proper for the following reasons:

Salt marshes serve to support marine organisms, including finfish and shellfish; serve to provide critical wildlife habitat; serve to remove pollutants from surrounding waters; serve to aid in erosion control and storm damage prevention; and are important to fishing, shell fishing, recreation, and wetland scenic views. A salt marsh produces large amounts of organic matter. A significant portion of this material is exported as detritus and dissolved organics to estuarine and coastal waters, where it provides the basis for a large food web that supports many marine organisms, including finfish and shellfish. Salt marshes also provide spawning and nursery habitat for several important estuarine forage finfish. Salt marsh plants and substrate remove pollutants from surrounding waters. The network of salt marsh vegetation roots and rhizomes bind the sediments together. The sediments absorb chlorinated hydrocarbons and heavy metals such as lead, copper, and iron. The marsh also helps retain nitrogen and phosphorous compounds which can cause algal blooms and changes in ocean plankton and plant communities, particularly eelgrass. The underlying peat serves as a barrier between fresh groundwater landward of the marsh and the ocean, thus helping to maintain the level of the groundwater. Salt marsh cord grass and underlying peat are resistant to erosion and dissipate wave energy, thereby providing a buffer that reduces wave damage and coastal erosion. A saltmarsh is an important feeding and spawning area for many types of fish and aquatic and terrestrial wildlife. The marsh, including its creeks and open water, also provides important shelter for many aquatic and migratory birds. Marshes help absorb pollutants, but there is a careful balance of nutrients and pollutant input which if exceeded will result in accumulation of pollutants and/or changes in the marsh community. Because the marsh is the basis for such a large food web, bioaccumulations of pollutants and toxins can mean that relatively low levels of pollutants may be detrimental. Some of the characteristics of salt marshes which are critical to their health and ability to protect wetland values include: the growth,

composition, and distribution of saltmarsh vegetation; the amount of flow and level of both tidal and fresh water; the water quality (including but not limited to turbidity, temperature, nutrients, pollutants, salinity, and dissolved oxygen), of both tidal and fresh water; the presence and depth of peat; rate of marsh productivity; and the diversity of the animals and plants making up the marsh community. Salt marshes provide excellent areas for bird watching, canoeing, and hunting. Characteristics of salt marshes that are critical to wetland scenic views are water quality, vegetative characteristics, and a sense of presence, expanse and biodiversity.

2. In view of the foregoing, whenever a proposed project involves removing, filling, dredging, altering, or building upon a salt marsh, the Commission shall find that the salt marsh is significant to the protection of the following interests: groundwater, erosion control, storm damage prevention, water pollution prevention, fisheries, shellfish, wildlife, recreation, and wetland scenic views. These findings may be overcome only upon a clear showing that the salt marsh does not play a role in protecting any of the interests given above and only upon a specific written determination to that effect by the Commission.

B. PERFORMANCE STANDARDS

Salt Marshes or Land within 100 feet of Salt Marshes shall be presumed significant to the interests protected by the Bylaw as referenced in Section A, therefore the following regulations shall apply.

1. Salt Marshes shall not be filled.

2. Salt hay may be harvested from a salt marsh only if performed in a manner which does not disturb the marsh substrate.

3. No proposed project in a salt marsh, or in lands within 100 feet of a salt marsh, shall destroy any portion of the salt marsh, change species composition of the marsh, have any adverse effect on salt marsh productivity, pollute the salt marsh, or adversely affect water quality.

4. All projects which are not water dependent shall maintain at least a 25-foot natural undisturbed area adjacent to a salt marsh. All structures which are not water dependant shall be no closer than 50 feet from a salt marsh, and all structures shall maintain an undisturbed two-foot separation to high groundwater. Fifty percent (50%) of the area between the 25-foot buffer and the 50-foot buffer shall not be altered. Additional soils and groundwater information may be required for applications in areas of high groundwater.

5. The septic leach facility of a septic system shall be at least 100 feet from the salt marsh.

6. Piers shall be constructed and maintained ~~in compliance with the Town of Nantucket Zoning Bylaws~~ using procedures determined by the Commission to be the best available measures to minimize adverse effects on the Interests protected by the Bylaw.

7. Elevated walkways ~~determined to be a water dependent~~ ~~use~~ shall be designed not to affect marsh vegetation or existing water circulation patterns.

8. Materials cannot be stored or deposited on a Salt Marsh.

9. Fertilizers shall be used in accordance with the "Best Management Practices for Landscape Fertilizer Use on Nantucket Island" (a copy of which is attached to these regulations as appendix A).

10. The Commission may impose such additional requirements as are necessary to protect the Interests Protected by the Bylaw.

2.07 SALT PONDS

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to the activities involving salt ponds are necessary and proper for the following reasons:

Salt Ponds provide excellent wildlife habitat. The high productivity of plants and phytoplankton provides food for shellfish, crustaceans, and juvenile fish. The bottom sediments and shallow water provide habitat for many bivalves. The ponds also serve as spawning and nursery areas for crabs and fish. The productivity of salt ponds and the food web they support provides ideal habitat for many types of wildlife, particularly various ducks and shore birds. The enclosed nature of the ponds also provides shelter for wildlife. Salt ponds and the area around them provide the public many recreational opportunities and wetland scenic views including: shellfishing, fishing, sailing, swimming, hunting, and wildlife observation. Because of their semi-enclosed nature, salt ponds are sensitive to pollution or nutrient inputs. These inputs can change the plant and animal species composition of the pond, and thus can be detrimental to fish, shellfish and wildlife. Bioaccumulation through food webs can also create dangerous levels of pollutants or toxins for wildlife and humans. Characteristics of salt ponds which are critical to various wetland values include water circulation, distribution of sediment grain size, amount of freshwater and saltwater inflow, productivity of plants, and water quality (including but not limited to amounts of dissolved oxygen, nutrients, temperature, turbidity, pollutants, and salinity). Land within 100 feet of a salt pond is considered to be significant to the protection and maintenance of a salt pond and the land beneath it and therefore to the protection of the wetlands values of the pond.

2. In view of the foregoing, whenever a proposed project involves removing, filling, dredging, altering, or building upon a salt pond, the Commission shall find that the salt pond is significant to the protection of the following interests: fisheries, shellfish, wildlife, recreation, and wetland scenic views. These findings may be overcome only upon a clear showing that the salt pond does not play a role in protecting any of the interests given above and only upon a specific written determination to that effect by the Commission.

B. Performance Standards

A Salt Pond or Land within 100 feet of a Salt Pond shall be presumed significant to the Interests Protected by the Bylaw as referenced in Section A, therefore the following regulations shall apply:

1. The work shall be done in accordance with procedures determined by the Commission to have no adverse effect on wildlife, fisheries, shellfish, existing water quality, recreation, or wetland scenic views and so as not to pollute the pond or alter the critical characteristics of salt ponds.

2. All projects which-are not water dependent shall maintain at least a 25-foot natural undisturbed area adjacent to a salt pond. All structures which are not water dependent shall be at least 50 feet from a salt pond, and all structures shall maintain an undisturbed two-foot separation to high groundwater. Fifty percent (50%) of the area between the 25-foot buffer and the 50-foot buffer shall not be altered. Additional soils and groundwater information may be required for applications in areas of high groundwater.

3. The septic leach facility of a septic system shall be at least 100 feet from a salt pond.

4. Projects designed to enhance a particular fishery or shellfish shall be designed in accordance with such procedures as the Commission determines will minimize adverse ecological effects on the salt pond, including adverse effects on plants and animals which are not the species targeted for management. If such management projects have adverse effects on any of the Protected Interests of the Bylaw, such projects shall be permitted only pursuant to a waiver, as set forth in Section 1.03F of these regulations.

5. Piers shall be constructed and maintained using procedures determined by the Commission to be the best available measures to minimize adverse effects on the Interests protected by the Bylaw.

6. Elevated walkways shall be designed not to affect vegetation or existing water circulation patterns. Elevated walkways shall be required to allow for pedestrian passage over the salt pond and fringing bordering vegetated wetlands.

7. Fertilizers shall be used in accordance with the "Best Management Practices for Landscape Fertilizer Use on Nantucket Island" (a copy of which is attached to these regulations as appendix A).

8. The Commission may impose such additional requirements as are necessary to protect the Interests Protected by the Bylaw.

2.08 LAND CONTAINING SHELLFISH

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that the regulations applicable to activities involving land containing shellfish are necessary for the following reasons:

Shellfish are one of the Interests Protected by the Bylaw. Land containing shellfish is found within many of the areas protected by this Bylaw. In addition to the regulations for those resource areas as given above in these regulations, this section discusses additional protection for shellfish. Land containing shellfish and its habitat is important to the protection of marine fisheries in addition to the protection of shellfish. Shellfish on Nantucket are a very important recreational and commercial natural resource. Bay scallops, in particular, are an important economic resource on Nantucket. Shellfish used as a human food resource, as they are on Nantucket, need very clean, uncontaminated water, since they have the ability to concentrate very low levels of pollutants. Shellfish are a valuable renewable resource. The maintenance of productive shellfish beds not only assures the continuance of shellfish themselves but also plays a direct role in supporting fish stocks by providing a major food source. Characteristics of land containing shellfish which are critical to the protection of shellfish include, but are not limited to: wildlife habitat, water circulation patterns, rates of water flow, and amounts of water; the relief and elevation, distribution, grain size, and pollutant load of the sediments; and water quality (including turbidity, temperature, pollutants, nutrients, salinity, and dissolved oxygen).

2. In view of the foregoing, whenever a proposed project involves removing, filling, dredging, altering, or building upon land containing shellfish or the water over land containing shellfish, the Commission shall find that the land containing shellfish is significant to the protection of the following interests: shellfish, fisheries, and recreation. These findings may be overcome only upon a clear and convincing showing that land containing shellfish does not play a role in protecting any of the interests given above and only upon a specific written determination to that effect by the Commission.

B. PERFORMANCE STANDARDS

Land Containing Shellfish or Land within 100 feet of Land Containing Shellfish shall be presumed significant to the Interests Protected by the Bylaw as referenced in Section A, therefore the following regulations shall apply.

1. Projects shall not adversely effect water quality (including but not limited to changes in turbidity, temperature, salinity, dissolved oxygen, and additional nutrients and pollutants), water circulation, aquatic vegetation, or natural drainage from adjacent land.

2. Land containing shellfish shall not be compacted by vehicular traffic or other means. The land's elevation and sediment grain size shall also not be altered.

3. Projects shall not obstruct the ability of the public to gather shellfish recreationally or the ability of commercial fishermen to harvest shellfish.

4. Any project which may release pollutants shall ~~use such procedures as the Commission determines to~~ utilize the best known technology to remove pollutants or prevent risk of pollution.

5. All septic leach facilities shall be at least 100 feet from land containing shellfish.

6. Fertilizers shall be used in accordance with the "Best Management Practices for Landscape Fertilizer Use on Nantucket Island" (a copy of which is attached to these regulations as appendix A).

7. No project detrimental to scallops shall be permitted, except activity allowed pursuant to a waiver from these regulations, as set forth in Section 1.03F.

8. Piers shall be constructed and maintained using the best available measures to minimize adverse effects on the Interests protected by the Bylaw.

9. The Commission may impose such additional requirements as are necessary to protect the Interests Protected by the Bylaw.

2.09 ANADROMOUS/CATADROMOUS FISH RUNS, BANKS ALONG FISH RUNS, AND LANDS UNDER FISH RUNS

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to activities involving fish runs are necessary and proper for the following reasons:

Fisheries are one of the Protected Interests under the Bylaw, Section 136-2. Anadromous and Catadromous fish are renewable protein resources that provide recreational and commercial benefits. In addition, throughout their life cycle such fish are important components of freshwater, estuarine, and marine environments and are food sources for other organisms. Fish runs provide habitats for other fish and shellfish. Characteristics of fish runs which are critical to the protection of anadromous/catadromous fish include: accessibility and location of spawning and nursing grounds, volume and rate of water flow in both migratory and spawning areas, water quality (including turbidity, temperature, pollutants, nutrients, salinity, and dissolved oxygen) and sediment and erosion control. Fish runs are important for wildlife habitat, recreation, and wetland scenic views.

2. In view of the foregoing, whenever a proposed project involves removing, filling, dredging, altering or building upon a fish run, the Commission shall find that the fish run is significant to the protection of the following interests: fisheries, wildlife, sediment and erosion control, water quality, wetland scenic views, and recreation. These findings may be overcome only upon a clear showing that the fish run and the land under a fish run does not play a role in protecting any of the interests given above and only upon a specific written determination to that effect by the Commission.

B. PERFORMANCE STANDARDS

Fish Runs or Land within 100 Feet of a Fish Run shall be presumed significant to the Interests Protected by the Bylaw as referenced in Section A, therefore the following regulations shall apply:

1. Proposed Projects shall not be permitted to fill a fish run, impede the migration of fish, or change the volume, rate, or quality of water flow in a fish run.

2. Proposed project shall not use procedures which the Commission determines are detrimental to spawning or nursery habitats necessary to sustain the various life stages of the fish.

3. All projects which are not water dependent shall maintain at least 25-foot natural undisturbed are adjacent to a fish run. All structures which are not water dependent shall be at least 50 feet from a fish run.

4. The septic leach facility of a septic system shall be at least 100 feet from the fish run.

5. All work in a fish run shall be prohibited between March 15th and June 15th in any year.

6. All projects, including road maintenance, shall use procedures as the Commission

determines will minimize the siltation of a fish run.

7. Elevated walkways designed not to affect water quality, sunlight penetration, water volume, or wetland scenic views shall be required for pedestrian passage over a fish run.

8. The Commission may impose such additional requirements as are necessary to protect the Interests Protected by the Bylaw.

2.10 LAND SUBJECT TO COASTAL STORM FLOWAGE

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to activities involving land subject to coastal storm flowage are necessary and proper for the following reasons:

Land subject to coastal storm flowage (the coastal floodplain) buffers and protects upland areas from severe storm conditions. Since the floodplain contains areas where the water table is close to the surface (as well as other wetland resource areas) pollutants in a floodplain, including contents of septic systems and fuel tanks, may affect private water supply, groundwater quality, wildlife, fisheries and shellfish during a storm. Direct and collateral damage to man-made structures in the floodplain are caused by wave impacts and inundation by flood waters and storm-driven debris. Desires of property owners to protect themselves from the effects of storms can lead to pressure on the Town and its regulatory bodies to erect engineering structures in wetlands which can have a detrimental effect on wetland values and public health and safety.

2. In view of the foregoing, whenever a proposed project involves removing, filling, dredging, altering or building upon land subject to coastal storm flowage, the Commission shall find that the land is significant to the protection of the following interests: flood control, erosion control, and storm damage prevention, water quality, erosion and sediment control, wildlife habitat. These findings may be overcome only upon a clear showing that land subject to coastal storm flowage does not play a role in protecting any of the interests given above and only upon a specific written determination to that effect by the Commission.

B. PERFORMANCE STANDARDS

Land Subject to Coastal Storm Flowage or Land within 100 feet of Land Subject to Coastal Storm Flowage shall be presumed significant to the Interests Protected by the Bylaw as referenced in Section A, therefore the following regulations shall apply:

(Specific resource areas that lie within the area of land subject to coastal storm flowage, and the

wetland values they protect, are otherwise addressed elsewhere in these regulations. The regulations concerning those areas are additional to the regulations set forth in this section.)

1. The work shall not reduce the ability of the land to absorb and contain flood waters, or to buffer inland areas from flooding and wave damage.

2. Projects shall not cause ground, surface, or salt water pollution triggered by coastal storm flowage. All septic tanks and leach facilities shall be located outside the 100-year floodplain.

3. All private underground fuel tanks shall be outside the 100-year floodplain. Commercial tanks shall be outside the 100-year floodplain, or if the Commission determines this is not practicable, the commercial tanks shall be secured so that they cannot float loose.

4. Building upon areas subject to coastal storm flowage in locations where such structure would be subject to storm damage may not be permitted. If permitted, all construction must be in compliance with state and local building code regulations for flood hazard areas.

5. Fertilizers shall be used in accordance with the "Best Management Practices for Landscape Fertilizer Use on Nantucket Island" (a copy of which is attached to these regulations as appendix A).

6. The Commission may impose such additional requirements as are necessary to protect the Interests Protected By the Bylaw.

2.11 ESTIMATED HABITAT FOR RARE/SIGNIFICANT WILDLIFE AND RARE/SIGNIFICANT FLORA AND FAUNA (for coastal wetlands)

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to activities involving estimated habitat for rare/significant wildlife and rare/significant flora and fauna for coastal wetlands are necessary and proper for the following reasons:

Any coastal resource area identified in Chapter 136-3 of the Nantucket Wetlands Protection Bylaw within which is found any state rare species (plant or animal) officially listed by the Massachusetts Division of Fisheries and Wildlife, or in which is found any species (plant or animal) the Commission has recognized as significant under the Bylaw, or any coastal resource area falling within any of the most recent Estimated Habitat Maps of the Massachusetts Natural Heritage and Endangered Species Program, shall be considered rare/significant species habitat, as defined in Section 1.02 of these regulations. Rare/significant species habitat preservation is important in order to maintain healthy ecosystems, wetland resources and biodiversity, and is important for protecting recreational interests, and in protecting wetland scenic views.

2. In view of the foregoing, whenever a proposed project involves removing, filling, dredging, altering or building within areas of estimated habitat for rare/significant wildlife and rare/significant fauna for coastal wetlands, the Commission shall find that such land is significant to the protection of the following interests: fisheries, shellfish, wildlife, biodiversity, recreation, and wetland scenic views. These findings may be overcome only upon a clear showing that these estimated habitat areas do not play a role in protecting any of the interests given above and only upon a specific determination to that effect by the Commission.

C. PERFORMANCE STANDARDS

Estimated habitat areas shall be presumed significant to the Interests Protected by the Bylaws as referenced in Section A, therefore the following regulations shall apply:

1. No activity shall be permitted that alters existing vegetation within 25 feet of verified rare/significant species habitat.

2. No activity shall be permitted that results in the construction or enlargement of a structure within 50 feet of verified rare/significant species habitat.

3. No alteration of topography (filling or cutting) and/or drainage characteristics shall be permitted within 50 feet of verified rare/significant species habitat.

4. No new construction or enlargement of drainage facilities within 25 feet of verified

rare/significant species habitat shall be permitted.

5. No part of any septic system shall be placed within 50 feet and no leaching facility shall be placed within 100 feet of a verified rare/significant species habitat.

6. The Commission may impose such additional requirements as are necessary to protect the Interests Protected by the Bylaw.

PART III - REGULATIONS FOR INLAND WETLANDS

3.01 INLAND BANKS AND BEACHES

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to activities involving inland banks and beaches are necessary and proper for the following reasons:

Inland banks and beaches aid in flood prevention; serve to provide, protect, and enhance habitat for rare, endangered, and significant wildlife and fauna; and serve to provide important wetland scenic views and recreation. Banks are areas where groundwater discharges to the surface and where, under some circumstances, surface water recharges the groundwater. Where banks are partially or totally vegetated, the vegetation serves to maintain the Bank's stability, which in turn protect water quality by reducing erosion and siltation. Banks act to confine floodwaters during most storms, preventing the spread of water to adjacent land. Alterations which permit water to frequently and consistently spread over a larger and more shallow area increase the amount of land routinely flooded and elevate water temperatures. Land within 100 feet of a Bank is likely to be significant to the protection and maintenance of the Bank, and therefore to the protection of the interests which these resource areas serve to protect. Banks may provide shade that moderates water temperatures as well as providing breeding habitat, escape cover, and feeding areas, all of which are important for the protection of fish. Banks may also help channel water and thus maintain a water depth which helps keep the water temperatures cool in warm weather, thus providing habitat necessary for both fish and the food sources for fish. Inland banks may act as a sediment source for inland beaches. By confining floodwaters, banks decrease the erosion of topsoil from adjacent land surfaces and help prevent flood and storm damage to buildings and roads. Confining floodwaters also decreases water pollution by preventing floodwaters from mixing with many contaminants found on roads, near and in dwellings, from fertilized soil, and from septic tanks. Banks may provide nesting habitat for some species of birds. Banks and particularly beaches provide wildlife and human access to water bodies. Characteristics that are critical to recreation are topography, vegetative cover, wildlife habitat, and access to and along the shore. Characteristics that are critical to wetland scenic views are relief and elevation; plant and animal habitat and diversity; and solitude.

2. In view of the foregoing, whenever a proposed project involves removing, filling, dredging, altering or building upon an inland bank or beach, the Commission shall find that the bank or beach is significant to the protection of the following interests: groundwater, flood control, erosion control, storm damage prevention, water pollution, fisheries, scenic views, and wildlife. These findings may be overcome only upon a clear showing that the inland bank or beach does not play a role in protecting any of the interests given above and only upon a specific written determination to that effect by the Commission.

B. PERFORMANCE STANDARDS

Inland Banks and Beaches or Land within 100 feet of an Inland Bank and Beach shall be presumed significant to the Interests Protected by the Bylaw as referenced in Section A, therefore the following regulations shall apply:

1. Projects shall be permitted only where no adverse effect exists on bank stability, groundwater and surface water quality, the water carrying capacity of an existing channel within a bank, bank height, and the capacity of the bank to provide habitat for fisheries and/or wildlife.

2. Elevated walkways designed not to affect bank vegetation shall be required for pedestrian passage over an inland bank (but not an inland beach that is gently sloping).

3. All projects which are not water dependent shall maintain at least a 25-foot natural undisturbed area adjacent to an inland bank or beach. All structures which are not water dependent shall be at least 50 feet from an inland bank or beach.

4. The septic leach facility of a septic system shall be at least 100 feet from the seasonal highest documented water line of the water body.

5. No structure of any kind shall be permitted on an eroding bank to protect any building built pursuant to a permit granted after the effective date of these regulations.

6. Piers shall be constructed and maintained using procedures determined by the Commission to be the best available measures to minimize adverse effects on Interests Protected by the Bylaw.

7. The Commission may impose such additional requirements as are necessary to protect the Interests Protected by the Bylaw.

3.02 VEGETATED WETLANDS (MEADOWS, MARSHES, SWAMPS, AND BOGS)

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to activities involving vegetated wetlands are necessary and proper for the following reasons:

Vegetated wetlands serve to support rare/significant species (plant and animal); serve to provide rare/significant species (plant and animal) habitat; serve to remove pollutants from surrounding waters; serve to aid in the prevention of flooding and are important to fishing, shellfishing, recreation, and wetland scenic views. The plant communities, soils, and associated low, flat topography of vegetated wetlands remove or detain sediments, nutrients (such as nitrogen and phosphorous) and toxic substances (such as heavy metal compounds) that occur in run-off and flood waters. Some nutrients and toxic substances are retained for years in plant root systems or in the soils. Others are held by plants during the growing season and released as the plants decay in the fall and winter. This latter phenomenon delays the effect of nutrients and toxins until cold weather period, when the release of these materials is less likely to reduce water quality. Vegetated wetlands are areas where ground water discharges to the surface and where, in some circumstances, surface water discharges to the ground water. The profusion of vegetation and the low, flat topography of vegetated wetlands slow down and reduce the passage of flood waters during periods of peak flows by providing temporary flood water storage, and by facilitating water removal through evaporation and transpiration. This reduces downstream flood crests, erosion, and resulting damage to private and public property. During dry periods the water retained in vegetated wetlands is essential to the maintenance of base flow levels in streams or into the groundwater which in turn is important to the protection of water quality, water supplies, and wildlife. Wetland vegetation provides shade that moderates water temperatures important to fish life. Vegetated wetlands that are always wet or that are flooded by adjacent water bodies and waterways provide food, breeding habitat, and cover for fish. Fish populations in the larval stage are particularly dependent upon food provided by these wetlands since they provide large quantities of microscopic plant and animal food material. Wetland vegetation provides habitat for a wide variety of insects, reptiles, amphibians, mammals, and birds. Many of these, particularly insects, are food source for fish. Vegetated wetlands, together with land within 100 feet of a vegetated wetland, serve to moderate and alleviate thermal shock and pollution resulting from runoff from impervious surfaces which may be detrimental to wildlife, fisheries, and shellfish downstream of the vegetated wetland. The maintenance of base flows by vegetated wetlands is significant to the maintenance of a proper salinity ratio in estuarine areas downstream of the vegetated wetland. A proper salinity ratio, in turn, is essential to the ability of shellfish to spawn successfully and therefore to provide for the continuing procreation of shellfisheries. A proper salinity ratio is also important for many species of fish. Vegetated wetlands are excellent places for birdwatching and hunting. Some vegetated wetlands, particularly bogs, provide habitat for rare plants and animals. Vegetated wetlands along pond edges can prevent erosion by wind driven waves and serve

to provide storage for floodwaters. Characteristics of vegetated wetlands that are critical to wetland scenic views are water quality, vegetative characteristics, habitat, and a sense of presence, expanse and biodiversity. Land within 100 feet of a vegetated wetland is considered to be significant to the protection and maintenance of vegetated wetlands, and therefore to the protection of the interests which these resource areas serve to protect.

2. In view of the foregoing, whenever a proposed project involves removing, filling, dredging, altering, or building upon a vegetated wetland, the Commission shall find that the vegetated wetland is significant to the protection of the following interests: public and private water supply, groundwater, flood control, erosion control, storm damage prevention, water pollution, fisheries, shellfish, wildlife, scenic views, and recreation. These findings may be overcome only upon a clear showing that the vegetated wetland does not play a role in protecting any of the interests given above and only upon a specific written determination to that effect by the Commission.

B. PERFORMANCE STANDARDS

Vegetated wetlands or Land within 100 feet of Vegetated Wetlands shall be presumed significant to the Interests Protected by the Bylaw as referenced in Section A, therefore the following regulations shall apply:

1. Proposed projects which are not water dependent shall maintain at least a 25-foot natural undisturbed area adjacent to vegetated wetlands. All structures which are not water dependant shall be at least 50 feet from a vegetated wetland, and all structures shall maintain an undisturbed two-foot separation to high groundwater. Fifty percent (50%) of the area between the 25-foot buffer and the 50-foot buffer shall not be altered. Additional soils and groundwater information may be required for applications in areas of high groundwater.

2. Proposed projects shall not use procedures that the Commission determines changes the flood protection function (leveling out of storm surges by storing and slowly releasing water) of vegetated wetlands by significantly changing the rate of water flow through the wetlands (by channelization or other means).

3. No permit shall be issued which authorizes the destruction of forested swamps. The Commission may authorize the excavation of other vegetated wetlands to create ponds or clear the edge of a pond if the project is designed to increase wildlife habitat diversity and to minimize groundwater or surface water loss.

4. The septic leach facility of a septic system shall be at least 100 feet from the vegetated wetland.

5. Piers shall be constructed and maintained using procedures determined by the Commission to be the best available measures to minimize adverse effects on Interests

Protected by the Bylaw.

6. Elevated walkways determined to be water dependent designed not to affect existing vegetation shall be required for pedestrian passage over vegetated wetlands.

7. Fertilizers shall be used in accordance with the "Best Management Practices for Landscape Fertilizer Use on Nantucket Island" (a copy of which is attached to these regulations as appendix A).

8. The Commission may impose such additional requirements as are necessary to protect the Interests Protected Under the Bylaw.

3.03 INLAND WATER BODIES (LAKES CREEKS, STREAMS, PONDS, DITCHES, AND FLATS)

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to activities involving inland water bodies are necessary and proper for the following reasons:

Where land under water bodies is composed of pervious material, such land represents a point of exchange between surface and ground water. Depending upon the hydrological conditions and water levels at a given point in time, these areas may serve as exchange or discharge points, or both, with groundwater. An area may serve as recharge area at one season and a discharge point at another time. This allows pollutants and nutrients easy access into private wells or the general groundwater supply. The physical nature of land under water bodies is highly variable, ranging from deep organic and fine sedimentary deposits to gravel and large rocks. The organic soils and sediments play an important role in the process of detaining and removing dissolved and particulate nutrients from surface water above. These also serve as traps for toxic substances (such as heavy metal compounds). Land under water bodies in conjunction with banks serve to confine floodwater within a definite channel during the most frequent storms. Filling within this channel blocks flows which in turn causes backwater and overbank flooding during such storms. An alteration of land under water bodies that causes water to frequently spread out over a large area at lower depth increases the amount of property that is routinely flooded. Additionally, it results in an elevation of water temperature and decrease in wildlife habitat in the main channel, both of which are detrimental to fisheries, particularly during periods of warm weather and low flows. It may also flood waterfowl nesting sites which otherwise would not be disturbed. Land under ponds and lakes is vital to a large assortment of warm water fish during spawning periods. Species such as large-mouth bass (Micropterus salomoides), small-mouth bass (Micropterus dolomieui), blue gills (Lepomis macrochirus), pumpkinseeds (Lepomis gibbous), black crappie (Pomoxis nigromaculatus), and rock bass (Ambloplites rupestris) build nests on the lake

and bottom substrates within which they shed and fertilize their eggs. Land within 100 feet of any bank abutting land under a water body is significant to the protection of the interests which these water bodies serve to protect. Characteristics of water bodies which are critical to wildlife, wildlife habitat, and fisheries include water circulation and flushing rates, distribution of sediment grain size, and water quality (including amounts of dissolved oxygen, nutrients, and pollutants). Leaving ponds and the land bordering ponds in an unobstructed state may be important to recreational swimming, fishing, and boating. Water bodies and the area around them also provide other recreational opportunities such as hunting and wildlife observation. Cattail borders or other vegetated borders of large ponds are important in reducing shoreline erosion and storm damage by dissipating the high energy of storm waves and by anchoring the sediments. Water bodies provide important feeding and/or drinking areas for many types of aquatic wildlife, birds, and animals. Ponds and other water bodies produce insects that hatch and are used as food by several species of birds, particularly swallows. Ducks, geese, swans, and herons all use water bodies and surrounding borders for feeding, shelter, and/or nesting areas. Many other birds, animals, reptiles, and amphibians use land under water bodies, water bodies, and the borders of water bodies for various parts of their life cycles. Changes in sediments, water quality, water level, or species composition of food sources or groundcover may be detrimental to any of the above wildlife and wildlife habitat. Ponds and the land surrounding them often form important wetland scenic views. The enclosed area and the limited size of most fresh water bodies on Nantucket make them particularly sensitive to pollution or nutrient inputs. These inputs can change the plant and animal species composition of the water body and thus can be detrimental to fish and wildlife. Bioaccumulation of pollutants through food webs can also create dangerous levels of pollutants or toxins for wildlife and humans.

2. In view of the foregoing, whenever a proposed project involves removing, filling, dredging, altering or building upon water bodies or the land beneath them, the Commission shall find that water bodies and the land beneath them are significant to the protection of the following interests: public and private water supply, ground water, flood control, erosion control, storm damage prevention, water pollution, fisheries, wildlife, scenic views, and recreation. These findings may be overcome only upon a clear showing that the water body or the land beneath it does not play a role in protecting any of the interests given above and only upon a specific written determination to that effect by the Commission.

B. PERFORMANCE STANDARDS

Inland Water Bodies or Land within 100 feet of an Inland Water Bodies shall be presumed significant to the Interests Protected by the Bylaw as referenced in Section A, therefore the following regulations shall apply:

1. No proposed project shall use procedures that the Commission determines have an adverse effect on significant wildlife habitat, wildlife, fisheries, existing water quality,

recreation, wetland scenic views, or alter the critical characteristics of an inland water body.

2. Proposed projects which are not water dependent shall maintain at least 25-foot natural
undisturbed area adjacent to land under water body. All structures which are not water dependent shall be at least 50 feet from land under a water body, and all structures shall maintain an undisturbed two-foot separation to high groundwater. Fifty percent (50%) of the area between the 25-foot buffer and the 50-foot buffer shall not be altered. Additional soils and groundwater information may be required for applications in areas of high groundwater.

3. The septic leach facility of a septic system shall be at least 100 feet from the water body and/or its bordering vegetated wetland, whichever results in the greater separation. Septic leach facilities shall be separated from each other by 200 feet if the lot containing one of them contains a water body or fronts on a water body and the septic location is within the jurisdiction of this Bylaw.

4. There shall be no filling of a water body, except as allowed pursuant to a waiver from these regulations as set forth in Section 1.03F.

5. Fertilizers shall be used in accordance with the "Best Management Practices for Landscape Fertilizer Use on Nantucket Island" (a copy of which is attached to these regulations as appendix A).

6. Boat piers shall be:

   a) constructed using those procedures that the Commission determines to be the best available measures to minimize adverse effects on the Interests Protected by the Bylaw; and

   b) The Commission may impose such additional requirements as are necessary to protect the Interests Protected under the Bylaw.

3.04 LAND SUBJECT TO FLOODING (BOTH BORDERING AND ISOLATED AREAS)

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to activities involving land subject to flooding is necessary and proper for the following reasons:

Bordering land subject to flooding provides a temporary storage area for floodwater which has overtopped the bank of the main channel of a creek, river, or stream or the basin

of a pond or lake. During periods of peak runoff, floodwaters are both retained (i.e. slowly released through evaporation and percolation) and detained (slowly released through surface discharge). Over time, incremental filling of these areas causes displacement of flooding effects and increases in the extent and level of flooding by eliminating flood storage volume or by restricting flows, and, thereby, increases in damage to public and private properties. Pollutants or contaminants located on bordering land subject to flooding may be washed into surface waters and from there to ground water, or percolate directly into ground water. Sources of pollutants within these areas thus have widespread effect on Interests Protected by the Bylaw. Bordering land subject to flooding provides an important source of microscopic plant and animal material which enriches the nearby water body, may serve as significant wildlife habitat, and can serve as the basis for a food web which supports many fish or wildlife. Bordering land provides important wildlife habitat and wildlife access to surface water resources. Bordering land subject to flooding is often low and level and thus helps prevent erosion of soil into water bodies by surface water run-off. The topography and location of bordering land subject to flooding is critical for protection of flood control capabilities. Isolated land subject to flooding provides a temporary storage area where run-off and high groundwater collect and slowly evaporate or percolate into the ground. These areas, even though small, usually are numerous and thus very important in preventing more serious flooding somewhere else. Filling causes lateral displacement of ponded water or increased run-off onto contiguous properties, which may result in damage to those properties and others which were not previously affected as much. The additive nature of the flood protection provided by these isolated areas and the fact that filling one may redirect water so as to radically change watershed sizes, means that small changes in one area may have large effects in another area. Isolated land subject to flooding helps prevent erosion by breaking up watersheds so that run-off does not become so great as to have enough force to erode soil. Areas where the isolated land subject to flooding is pervious are likely to serve as significant recharge points to the groundwater aquifer. Contamination in the area may find easy access into groundwater and neighboring wells. Isolated land subject to flooding which is covered by a mat of organic peat or muck may help remove contaminants before the floodwater enters the ground water. Isolated land subject to flooding may provide important wildlife habitat for amphibians, particularly during their breeding period, and some rare plants. It also may provide important wildlife habitat for several species of birds, including ducks.

2. For the foregoing reasons, whenever a proposed project involves removing, filling, dredging, altering, or building upon land subject to flooding, the Commission shall find that the land is significant to protection of the following interests: private water supply, ground water, flood control, erosion control, and water pollution. These findings may be overcome upon a clear showing that the land subject to flooding does not play a role in protecting any of the interests given above, and only upon a specific written determination to that effect by the Commission.

B. PERFORMANCE STANDARDS

Isolated Land Subject to Flooding or Land Within 100 feet of Isolated Land Subject to Flooding shall be presumed significant to the Interests Protected by the Bylaw as referenced in Section A, therefore the following regulations shall apply:

1. Work on isolated wetlands and small ponds is subject to the regulations set forth in Section 3.03 (Ponds) and Section 3.02 (Vegetated Wetlands).

2. Projects on land subject to flooding shall be permitted only in connection with such procedures determined by the Commission as not having the effect of reducing the ability of the land to absorb and contain floodwaters.

3. If such a site is available on the applicant's land, all septic tanks and leach facilities shall be located outside the 100-year floodplain.

4. Underground fuel oil or gasoline tanks, or tanks designed to hold any hazardous substance, shall not be permitted on land subject to flooding.

5. Proposed projects shall employ such safeguards as determined by the Commission to preclude ground water or surface water pollution triggered by flooding.

6. The Commission may require compensating or greater flood storage capacity in the same watershed if it permits any filling of land subject to flooding, and all filling of areas subject to flooding shall be strictly minimized. Except as stated in the preceding sentence, no proposed projects shall be permitted to displace or direct floodwaters, through fill or other means, to other areas.

7. Building upon areas subject to flooding shall be in compliance with appropriate state and local building code requirements.

8. Proposed projects in land subject to flooding shall use such procedures as the Commission determines will minimize their effect on wildlife.

9. Fertilizers shall be used in accordance with the “Best Management Practices for Landscape Fertilizer Use on Nantucket Island” (a copy of which is attached to these regulations as appendix A).

10. The Commission may impose such additional requirements as are necessary to protect the Interests Protected by the Bylaw.

3.05 ESTIMATED HABITAT FOR RARE/SIGNIFICANT WILDLIFE AND RARE/SIGNIFICANT FLORA AND FAUNA (for inland wetlands)

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to activities involving estimated habitat for rare/significant wildlife and rare/significant flora and fauna for inland wetlands are necessary and proper for the following reasons:

Any inland resource area as defined in Chapter 136-3 of the Nantucket Wetlands Protection Bylaw within which any state rare species (plant or animal) officially listed by the Massachusetts Division of Fisheries and Wildlife; any area defined as a vernal pool in Section 1.02 of these regulations; any species (plant or animal) the Commission has recognized significant as defined in Chapter 136-1 of the Bylaw; or any inland wetland resource area falling within any of the most recent Estimated Habitat Maps of the Massachusetts Natural Heritage and Endangered Species Program shall be considered rare/significant species and habitat, as defined as habitat in Section 1.02 of these regulations. Rare/significant species and habitat preservation is important in order to maintain healthy ecosystems, wetland resources and biodiversity; important for protecting recreational interests, and important in protecting wetland scenic views.

2. In view of the foregoing, whenever a proposed project involves removing, filling, dredging, altering, or building within areas of estimated habitat for rare/significant wildlife and rare/significant flora and fauna for inland wetlands, the Commission shall find that such land is significant to the protection of the following interests: fisheries, shell fisheries, wildlife, biodiversity, recreation, and wetland scenic views. These findings may be overcome only upon a clear showing that these estimated habitat areas do not play a role in protecting any of the interests given above and only upon a specific determination to that effect by the Commission.

B. PERFORMANCE STANDARDS

Estimated habitat areas shall be presumed significant to the Interests Protected by the Bylaws as referenced in Section A, therefore the following regulations apply:

1. No activity shall be permitted that alters existing vegetation within 50 feet of verified rare/significant species habitat, including certified vernal pools, and vernal pools defined in Section 1.02.
2. No activity shall be permitted that results in the construction or enlargement of a structure within 75 feet of verified rare/significant species habitat, including certified vernal pools, and vernal pools defined in Section 1.02.

3. No alteration of topography (filling or cutting) and/or drainage characteristics shall be permitted within 50 feet of verified rare/significant species habitat, including certified

vernal pools, and vernal pools defined in Section 1.02.

4. No new construction or enlargement of drainage facilities within 50 feet of verified rare/significant species habitat, including certified vernal pools, and vernal pools defined in Section 1.02, shall be permitted.

5. No part of any septic system shall be placed within 50 feet, and no leaching facility shall be placed within 100 feet, of a verified rare/significant species habitat, including certified vernal pools, and vernal pools defined in Section 1.02.

6. The Commission may impose such additional requirements as are necessary to protect the Interests Protected by the Bylaw.

3.06 RIVERFRONT AREA

A. CHARACTERISTICS AND PROTECTED INTERESTS

1. The Commission finds that regulations applicable to activities within the riverfront area (except as these activities are located within other wetland resource areas) are not appropriate for the following reasons:

   a) A riverfront area is the area of land between a river's mean annual high water line and a parallel line measured horizontally outward to a distance of 200 feet. The riverfront area may include or overlap other wetland resource areas or their buffer zones. The riverfront area does not have a buffer zone. Rivers begin at the point an intermittent stream becomes perennial, discharging throughout the year.

   b) Based on direct observation, periodic monitoring and inventory data and testimony provided by and to the Commission, rivers, as defined in Section 1.02 of these regulations and as defined in 310CMR10.58(2) of the State Wetlands Protection regulations, do not exist within the Town of Nantucket. Existing waterbodies on Nantucket that contain flowing water that empties into fresh and/or salt surface water bodies are intermittent, man-made canals or mosquito ditches, or exhibit dominant characteristics of tidally influenced flow.

   c) Therefore, for the purposes of the Town of Nantucket Wetland Protection Bylaw Regulations the Commission finds that no Riverfront Area wetland resource areas exist on Nantucket.

PART IV ACTIVITIES IN THE BUFFER ZONE

4.01 INTRODUCTION

Since 1983 the Massachusetts Department of Environmental Protection and the Town of Nantucket Conservation Commission have determined that activities within the 100-foot buffer zone pose a significant risk to the health of wetland resource areas. Therefore a Request for Determination of Applicability or Notice of Intent must be filed for all activities proposed within the buffer zone to these resource areas.

4.02 SIGNIFICANCE

The role that a protective buffer zone plays in the maintenance of healthy resource areas has been discussed in scientific literature for decades. Documentation exists that shows (Omernik 1977) a direct relationship in increased nitrogen and phosphorous loading to wetlands and waterbodies as their adjacent watersheds are cleared. Water quality can be better maintained if undisturbed protective buffer strips are maintained and preserved along surface water bodies. Adverse impacts from sediment erosion and transport are also minimized with the maintenance of an undisturbed buffer between the site development and the wetland resource area. Further, the transitional assemblage of trees, shrubs, and groundcover found in undisturbed buffer zones has been found significant to the support of a greater number of native wildlife species and fauna (biodiversity) in the interior of resource areas which they border.

4.03 CUMULATIVE IMPACT

Although the Town of Nantucket Wetlands Protection Bylaw (Chapter 136) defines significant cumulative effects as criteria for denying a project, permit level activities (i.e. site disturbance) are difficult to measure on a scale of cumulative impacts (watersheds). Cumulative effects result from individually minor but collectively significant actions taken place over a period of time. The level of information required and techniques employed for individual permit review are generally not sufficiently definitive to accurately assess potentially significant cumulative impacts, even though it may be clear that the collective impact of many such activities could adversely effect a wetland resource area. The best protection against cumulative impacts is the maintenance and preservation of an undisturbed buffer zone.

4.04 FILING REQUIREMENTS AND BUFFER ZONE SETBACKS

Based on available information, the Commission has determined that, generally, maintenance of a 25-foot undisturbed vegetative buffer zone and a 50-foot structure-free buffer zone will serve to protect most wetland resource areas from adverse impacts related to development elsewhere within the Buffer Zone.

Work proposed within 50-feet of a wetland resource area shall require the filing of a Notice of Intent. Work proposed outside of the 50-foot setback may be eligible for a Negative Determination of Applicability, provided the proposed work does not fall within an area mapped as rare or significant habitat or as a vernal pool by appropriate state and/or local agencies or departments; does not border on an Outstanding Resource area; provides erosion and sediment controls; and establishes a work limit at or greater than 50 feet from any wetland resource area, exclusive of land subject to coastal storm flowage.

It sometimes is necessary to impose additional restrictions on activities within the 100-foot buffer zone to prevent potential adverse effects on resource areas.

PART V ACTIVITIES TO ENHANCE WETLAND RESOURCE HEALTH AND FUNCTION

5.01 INTRODUCTION: Invasive Exotic Plants

The Commission defines exotic invasive plants as non-native species that have spread into native or minimally managed plant systems in Nantucket, causing economic or environmental harm by developing self-sustaining populations and becoming dominant and/or disruptive to those systems. On Nantucket, this may include species that are native to the mainland, but do not occur naturally on the island. Invasive plants are those species that spread widely beyond the location of initial establishment, become locally abundant, or spread into natural areas. Invasive species may cause net harm to the economy, environment and human health. While native species may be "invasive" in certain habitats, this section is concerned with invasive-exotic plant species, which will henceforth be abbreviated as "invasive" plants or species. Invasive plants often posses some of the following characteristics that increase their ability to replace native species: rapid growth and maturation; abundant seed set and/or asexual reproduction; rapid rates of spread; and few, if any, natural enemies. Invasive plants are often difficult to control and may form monocultures over large areas.

Invasive plants incursions can result in significant alteration to natural resource systems including wetlands and wetland buffers. Invasive plants may alter habitats sufficiently to reduce or eliminate less competitive plant species and /or wildlife dependant on specific habitats resulting in reduced biodiversity. In addition invasive plants may increase the rate of wetland eutrophication, reduce wetland area, and decrease pollutant attenuation. Effective management of invasive plants in wetlands and wetland buffers is critical to insuring and promoting healthy, diverse, and properly functioning wetland resources.

Determining the point and extent at which a resource or plant community has become adversely impacted by invasive species is dependant upon local conditions. Natural resource managers, landowners and natural resource beneficiaries on Nantucket recognize invasive plants to be a problem that currently exists within our wetland resources and buffers. In addition, it is

widely recognized that early detection and intervention makes control of invasive species easier with fewer environmental impacts. The process and regulations outlined below are set forth to define, guide and permit the management of invasive plants adversely impacting wetlands and wetland buffers within the jurisdiction of the Commission.

5.02 CONTROL/MITIGATION OF INVASIVE PLANT SPECIES

A. INVASIVE-EXOTIC PLANT SPECIES

1. The following list includes plants recognized as invasive in Massachusetts; importation and propagation of these species is currently prohibited within the state of Massachusetts. The entire current list of Massachusetts Prohibited Plants is available at the Massachusetts Department of Agricultural Resources, or may be accessed online at: http://www.mass.gov/eea/agencies/agr/farm-products/plants/massachusetts-prohibited-plant-list.html

The original MA prohibited plants list went into effect January 1, 2006. Certain species were subject to a phase-out period that expired on January 1, 2009. As of this date, the sale, trade, purchase, distribution and related activities for the species on the list not allowed. See Appendix B for the list.

2. Please see Appendix C for plants currently recognized by the Invasive Plant Species Committee of the Nantucket Biodiversity Initiative as invasive or at high risk of becoming invasive to native plant communities on Nantucket.

3) Marine algae currently recognized by the Nantucket Conservation Commission as invasive in Nantucket waters.

SCIENTIFIC NAME	COMMON NAME
Anabaena subcylindrica	
Asterionella formosa	
Chaetoceros elmorei	
Chlorella vulgaris	
Cladophora glomerata	
Codium fragile	Oyster thief
Enteromorpha linza	Maiden hair
Lyngbya birgei	
Nitzschia bilobata	
Oscillatoria rebescens	
Ulva lactuca	Sea lettuce

B. CONTROL/MITIGATION STRATEGIES

Appropriate and effective techniques to control invasive plants are species and location dependent. In developing a strategy to mitigate and/or control invasive plants, the following information is necessary:

- Identification of invasive species to be "controlled"
- Justification for identifying plant as invasive
- Delineation of geographic occurrence
- Identification of best management practice or practices to be used for treatment/eradication including plant disposal.
- Ongoing management strategy, including revegetation with appropriate species when required.

1. Identification of Invasive Species to be "controlled".

All plant species listed in Sections 5.02(A)(1-3) shall be considered to be invasive on Nantucket. The Commission may also consider plant species not on these lists to be invasive in certain habitats or under certain circumstances. All invasive species listed in Section 5.02(A)(1-3) are subject to control through the processes and regulations indicated in Section 5. Plant species listed as "Prohibited in Massachusetts" in Section 5.02(A)(1) and/or as "highly invasive" in Section 5.02(A)(2) shall not be planted within any wetland resource area or its protective buffer. The Commission recognizes that certain species act as invasive only in specific habitats. Therefore the Commission may grant permission to plant species listed as invasive on Nantucket, with the exception of plant species listed as "Prohibited in Massachusetts" in Section 5.02(A)(1) and/or as "highly invasive" in Section 5.02(A)(2) under certain circumstances, provided that the applicant can provide substantial evidence that the plants under consideration pose no threat to the resource area in question.

2. Delineation of geographic occurrence

Delineation of geographic occurrence of invasive species shall be provided by outline on aerial photographs of known scale and date; on GIS maps provided by the Town of Nantucket or appropriate land survey professionals; by plans drawn and stamped by professional land surveyors; and/or other appropriately scaled and stamped base sheet reference. Documentation shall include but not be limited to:

a) Measured and/or calculated percentage of ground/canopy cover (dominance) based on specific site grid data.

b) Graphic representation of aerial extent using specific site references such as aerial photographs, vista photographs, topographic and/or plot plans, etc.

c) Scientific and/or historic/anecdotal information as to invasive species impact to plant and animal biodiversity to the site and site environs.

3. Identification of best management practice or practices to be used for

treatment/eradication.

Best management practices for treatment and/or eradication of invasive plant species include:

a) Manual/mechanical removal

b) Chemical control (broadcast and directs plant application)

c) Biological control and/or

d) A combination of all of the above

e) Proper disposal

For purposes of the Nantucket Wetlands Protection Bylaw Regulations best management practices for the treatment and/or eradication of invasive plant species shall be those practices deemed both effective and with minimal environmental impacts including impacts to other plants or animals within or near the infestation. Ranking of best management practices shall be species and habitat specific and based on best available information from local, state and federal environmental agencies experienced with such efforts such as, but not limited to, the Massachusetts, Connecticut and New Hampshire Departments of Environmental Protection; the Vermont Agency of Natural Resources, Water Quality Division; the Massachusetts Division of Fisheries and Wildlife; the USDA/Natural Resource Conservation Service; the Environmental Protection Agency; the US Fish and Wildlife Service; the Nantucket Conservation Commission; the Nantucket Parks and Recreation Commission; the Nantucket Coastal and Marine Department; The New England Wild Flower Society; and the Nantucket Invasive Plant Species Committee. Management protocols developed by the Nantucket Invasive Species Committee for commonly treated invasive species are available from the town Natural Resources Department or from the Nantucket Biodiversity Initiative Website.

Any herbicide application shall be performed by or under the supervision of a licensed applicator. Techniques that minimize the amounts of herbicide used and that restrict herbicide application to the target species to the extent possible to still be effective are encouraged. Given the inherent risks associated with biological control techniques, the Commission will consider such methods only when other methods have failed or cannot be used in a given situation. Before a biological control technique can be employed it must be proven to be effective and to pose no risk to non-target plants on the island as a whole.

The seeds, proagules, and vegetative portions of some invasive plant species can survive indefinitely even after removal from the soil and initiate new infestations if not disposed of properly. Therefore best management practices must also include the proper disposal of such species.

4. Ongoing management strategy

Treatment, control, and/or eradication of invasive species often require more than one year of treatment and must include ongoing maintenance practices that serve to enhance the biodiversity and health of the wetland resource area and its environs. For the purposes of the Nantucket Wetlands Protection Bylaw Regulation, best management practices that serve to advance these interests include:

a) Integrated management practices that incorporate mechanical, chemical and/or biological control measures as appropriate including an estimate of the time required to effect control or elimination and any changes in treatment that may occur over time.

b) Effective erosion control measures

c) Competitive plantings and/or revegetation with appropriate native species. For small or scattered occurrences within intact native plant communities it may be appropriate to allow for natural revegetation

d) Wildlife management practices.

Prior to issuance of a decision to allow work to go forward, the Nantucket Conservation Commission shall require a written management plan that addresses Nantucket Wetlands Protection Bylaw Regulations Section 5.02 (B)(5) items a-d above, as appropriate to specific site conditions.

5.03 PERMITTING REQUIREMENTS

Under the provisions of the Nantucket Wetlands Protection Bylaw Regulations, alteration within a resource area and of vegetation within 25 feet of a wetland resource area has required an Order of Conditions from the Commission.

The Nantucket Conservation Commission has determined that appropriate treatment of invasive species within wetland resource areas and environs serves to enhance the functioning of the wetland resource area. Therefore, the Commission encourages, and will assist as appropriate, responsible invasive species management activities within its jurisdiction. In general, the Commission encourages early detection and control of invasive plants as removal is then often simpler with fewer environmental impacts.

Toward that end, the Commission herein grants waivers to provisions within the Nantucket Wetlands Protection Bylaw Regulations that require a 25 foot undisturbed buffer to wetland resource areas and/or the filing of a Notice of Intent to alter existing vegetation within those geographic areas. Any work to be undertaken within the buffer zone relative to invasive species management/control shall require the filing of a Request for Determination of

Applicability. Any work to be undertaken within a wetland resource area or within a wetland buffer that is know to support any species listed as Endangered, Threatened, or Special Concern by the Massachusetts Natural Heritage and Endangered Species Program shall require an Order of Conditions or Amended Order of Conditions resulting from public hearing review of a Notice of Intent. The applicant, landowner, and/or land manager shall provide for Commission review and approval all the information necessary to describe proposed invasive plant mitigation and control as required in the Nantucket Wetlands Protection Bylaw Regulations Section 5.02(B) (1-4).

Appendix A
Best Management Practices for Fertilizer Use on Nantucket Island

Appendix B
Massachusetts Prohibited Plants List

Appendix
Nantucket Invasive Species Committee Plants List

Best Management Practices for Landscape Fertilizer Use on Nantucket Island

Prepared by the Article 68 Work Group

2010–2012

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- Mark Lucas – Nantucket Golf Club, Golf course manager
- Wendy McCrae – Representative from the Shellfish & Harbor Advisory Board
- Michael Misurelli – Representative from the landscaping profession
- Seth Rutherford – Member from the community at large
- Ernie Steinauer – Mass Audubon, Representative from the Conservation Commission

Ex Officio

- David Fronzuto – Harbor Master/Marine Superintendent
- Richard Ray – Health Inspector

Administrative Assistant

- Jim Sutherland

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Section 1

Introduction

THE PURPOSE OF *BEST MANAGEMENT PRACTICES FOR NANTUCKET* [*BMP*] is to provide science-based guidelines for fertilizer use and other landscape practices that, when followed, reduce the loss of soil nutrients from excessive, incorrectly timed, or inappropriate fertilizers. On Nantucket, lost nutrients find their way rapidly to the coastal waters, harbors, ponds, and streams where they may cause contamination that is harmful to aquatic organisms as well as to human health and welfare.

Objectives of the *BMP* are:

- To provide landscape professionals and homeowners with information for making environmentally sound landscaping decisions that take Nantucket's unique conditions and natural resources into consideration;
- To promote the protection of water resources while maintaining healthy and vibrant ornamental landscapes;
- To reduce the amount of fertilizer use by promoting cultural practices that help reduce nutrient inputs;
- To offer site-planning guidelines and suggestions for ecological restoration that help reduce island-wide fertilizer-dependent landscapes;
- To provide science-based guidance for nutrient management of lawns and gardens on Nantucket.

In 2010, Nantucket Annual Town Meeting authorized the Board of Selectmen [BOS] to introduce legislation to the Massachusetts State Legislature via the Home-Rule Petition (HRP) process to regulate the use of fertilizers in the Town and County of Nantucket. To assist in the process, the BOS appointed the Article 68 Work Group [WG] comprising representatives from interested groups in the community. The WG was charged to recommend constructive changes in perfecting the language of the proposed HRP legislation and to develop a comprehensive plan to reduce the amount of nitrogen and phosphorus contributed by landscape fertilizers in our waters. The WG concluded that, as the basis of its recommendations, it would create a *BMP* specific to Nantucket's climate and soil conditions as an educational document that incorporates the latest turf and soil science for safe and effective landscape-fertilizer management on Nantucket. The principles contained in the *BMP* would provide a foundation for the regulatory package developed for the HRP and for any subsequent use by Nantucket's Board of Health.

Nantucket's glacial soils are dominated by deep sands and gravels with low organic-matter [OM] content. These soils readily allow water to infiltrate and are particularly prone to leaching of fertilizer and other pollutants. Leaching is the loss of nutrient from the soil by water-based dissolution and transport. Nitrogen that reaches our waters comes from a variety of sources. Although the largest percentage comes from atmospheric deposition of combustion-caused nitrates (automobile and power-plant exhaust); other human-related land uses contribute a significant amount.

Exact percentages are nearly impossible to measure, but among the major N contributors from land-based uses are septic systems, road and roof runoff, and excessive or inappropriately applied fertilizers from both agricultural and landscape practices. Nutrient leaching from improper fertilizer use is one of the controllable contributing factors to the degradation of our groundwater and surface water bodies. It is estimated that approximately 10 to 19 percent of the nitrogen applied to turf on Cape Cod soils, which are similar to Nantucket's, eventually leaches into groundwater [Petrovic, 2008; Horsely Witten Group, 2009]. It is likely that N-loss rates may be higher for ornamental plantings than for turf [Cisar et al., 2003; Erickson et al., 2001]. The control of fertilizer application, along with controls on septic and sewer systems, will help reduce degradation of the critical resources of Nantucket's waters.

In recent decades, Nantucket has experienced significant land development resulting in increased N and phosphorus [P] inputs from land-based uses, including many high- maintenance lawns and gardens that are regularly fertilized. Continued development of the island and increases in atmospheric deposition further threaten our water resources and demonstrate the need for increased awareness of landscape choices and practices that reduce both N and P inputs without sacrificing the appeal of well-maintained landscapes or the health of our water resources.

Nantucket Island has abundant freshwater and saltwater resources. Nitrogen is the limiting nutrient for saltwater and some freshwater systems while phosphorus is most often the limiting nutrient for freshwater systems. Excessive concentrations of N in saltwater and P in freshwater will facilitate algae blooms and various levels of eutrophication. These algal blooms can be toxic to marine life and, in some cases, to humans, pets, and livestock.

The WG assigned a subgroup to review the 2003 *BMP for Turf, Tree, and Shrub Fertilization on Nantucket Island,* an earlier document produced by the Nantucket Landscape Association, and to make recommendations for updating and improving it. This resulting document incorporates and expands upon much of the previous Nantucket-based material with added guidelines from a number of other relevant sources. The recommendations and guidelines presented in this document reflect the experience and knowledge of Nantucket landscape professionals and have been peer reviewed by turf and soil scientists. Those reviewers are identified and thanked in the Acknowledgments. They voluntarily gave invaluable service to Nantucket, and we are in their debt.

This *BMP* is the educational document that will provide Nantucket landscape professionals and interested homeowners with information necessary for effective turf and garden fertilizer management with the larger aim of protecting our aquatic resources. It is derived from documents gathered by other entities interested in managing fertilizer applications, from newly written guidance documents for turfgrass management, from standard textbooks on soil and turf science, from the experience of the Article 68 Work Group members, and from members of the scientific and academic communities who gave freely of their knowledge when reviewing this work.

Section 2

Site Assessment and Planning

- **Site assessment is a stage in the construction-design process in which the pre-existing physical and biological conditions of a site are identified and used as the basis for developing a plan that takes best advantage of the existing conditions.**
- **Site assessment should include the following: determination of building and other construction envelopes; soil characteristics as determined by soil tests; land forms and contours; view-sheds; micro climate conditions including winds, temperatures, and sun exposure; a plant inventory; and identification of areas of critical environmental concern including wetlands and rare plant communities or animal populations.**
- **The site plan for new construction should take advantage of existing landforms, minimize disturbance to lands not slated for development, and conserve topsoil for post-construction landscaping.**
- **Landscape plans should aim to minimize areas requiring supplemental fertilization and include undisturbed natural areas where possible.**
- **Site planning for renovations to existing landscapes should include identification of all of the above conditions plus: an as-built plan delineating location and type of landscaped areas; irrigation system; other subsurface utilities; a fertilization history; a history of existing and potential problems; and any owner expectations for change and improvement.**
- **Site planning for the many areas of the island in proximity to wetland resource areas—including harbors, ponds, and marshes—must follow the guidelines and procedures of the Nantucket Conservation Commission.**

Site assessment is the identification and recording of site conditions, including areas of environmental sensitivity, that factor into how a site is developed. This fundamental information is used for site planning and determining how a particular property will be designed or renovated and managed.

In order to thrive and grow, most lawns, gardens, and man-made landscapes are dependent on varying degrees of alteration to natural ecosystems. Site planning determines how much of the area of a particular property will require fertilizers for proper management. Site planning that incorporates the preservation of naturally existing vegetation, on a site-by-site basis, plays an important role in reducing island-wide fertilizer use. Whenever self-sustaining natural plant communities can be preserved, either adjacent to or as components of manmade landscapes, fertilizer use island-wide is reduced.

Identifying Site Conditions

The Town of Nantucket's Web GIS Map Page is a useful resource for identifying some basic Nantucket site conditions. [http://host.appgeo.com/nantucketma/]

The following site conditions form the basis for site planning:

- Soil characteristics obtained with a comprehensive soil test from a reputable laboratory to determine soil pH, texture, and nutrient analysis. [See Section 3: "Soil Nutrient Analysis: The Importance of the Soil Test" for detailed information on soil testing, interpretation, and application.]
- Prevailing and storm-related seasonal winds
- Seasonal patterns of sunlight exposure

- Land contours and elevations and how they influence drainage patterns and variations in microclimate
- Existing plant communities including trees, shrubs, grasslands, and invasive plants if present. Particular attention should be paid to rare plant and animal populations as determined by the Massachusetts Natural Heritage and Endangered Species Program.
- Environmentally sensitive areas such as wetland resource areas, as determined by the Nantucket Conservation Commission
- Desirable and undesirable views

Site Planning for New Construction

Careful site planning for construction on undisturbed lands is related to best management practices aimed at reducing landscape-related fertilizer use island-wide. On Nantucket, many new residences are built on, or adjacent to, relatively undisturbed natural areas. Naturalized plant communities consist primarily of plant species that have developed since grazing and farming practices were largely abandoned in the 1800s and are adapted to Nantucket's climate and soil conditions. Existing self-sustaining plant communities may be preserved for screening, as buffers to sensitive wetlands, or incorporated as integral aspects of the man-made landscape.

Planning for a site prior to construction starts by identifying the conditions listed above, then determining the maximum use area, or building envelope, needed both during and after construction. When preparing the landscape for new construction, it is recommended to identify the necessary building area including septic-system installation and other underground site work. Once the building envelope has been determined, existing topsoil should be carefully stripped and stockpiled within the work area. Desirable natural vegetation outside the building envelope should be fenced to avoid construction-related damage. During the construction process, areas down grade from stripped land should be protected from runoff with either siltation fencing or hay bales.

Oftentimes, more land needs to be disturbed for construction on a site than will be necessary for a well-designed man-made landscape. It is recommended that disturbed areas of a property unnecessary for the finished landscape plan be restored with low- maintenance plantings that do not require management with fertilizers or irrigation. [See Section 11: "Alternative Naturalistic Style Practices" for more on low-maintenance landscape alternatives.]

Soil is inevitably damaged during construction, but some practices help minimize the damage. When undisturbed land within the building envelope consists of brush or old field grasses, it should be brush cut, then rototilled before stripping and stockpiling. Where space allows, stockpiling of stripped topsoil in windrows instead of one large pile is less damaging to the microbiology of the soil. To determine nutrient or OM needs for turf or garden practices, any removed topsoil should be tested both while being stored and after being spread. A cover crop such as winter or annual rye applied to stockpiled topsoil may help minimize damage to stored soil and provide some OM content.

An important and often overlooked aspect of finish grading after construction is to improve subsoil that has been compacted by heavy machinery and vehicular traffic during construction. When possible, the transition from subsoil to amended topsoil should be gradual rather than

abrupt by mixing some topsoil to the top layer of subsoil. When this practice is followed, air and water movement through the soil will benefit, contributing to plant health and vitality.

Site Assessment for Existing Managed Landscapes
Site assessment for managed landscapes starts by identifying the same conditions listed above with additional information as listed below. Assessment of an existing man-made landscape may be desirable to identify and correct problem areas, or when considering a renovation or change in management approach.

Some additional information to gather for assessing an existing manmade landscape:

- An as-built landscape plan, if available, showing major features and use areas
- Square footage of turf and garden areas being managed
- As-built drawings showing underground utilities
- An as-built irrigation plan or diagram
- The functional condition of existing irrigation system and drainage patterns
- A history or summary of recent fertility management
- A list of current or potential problem areas
- A list of client/owner requirements and expectations

Choosing a Management Plan
Developing a management plan for either a new or existing property depends on clear communication of options and choices between the property owner and the landscape professional or professionals involved in the design and maintenance of the property.

In choosing a management plan for lawn areas in particular, the higher the level of quality desired and the more intense the use, the higher the level of management necessary to maintain a quality surface. High-maintenance turf uses include playing fields, croquet surfaces, and suggest golf course quality turf. A lower-maintenance turf, with lower use levels, where “perfection” is not a priority and some weeds are tolerated, will require less intense management.

Once high-use areas such as lawns and gardens or other planting areas are determined, it is important to decide how to transition to undisturbed areas of a property whether they are environmentally sensitive or simply existing natural plant communities.
Recommended edge plantings, sometimes referred to as buffer plantings, consist of low-maintenance naturalistic style plantings. [See Section 11: “Alternative Naturalistic Style Practices.”]

Section 3

Soil Analysis: The Role of the Soil Test

- **Regular soil tests are necessary components of any turf or ornamental-planting management program that includes fertilization or the addition of soil amendments.**
- **A soil test provides the following information: soil pH; the amounts of plant nutrients present; soil texture and organic matter content: cation exchange capacity; and recommendations for fertilization, pH adjustment, and soil amendments.**
- **A soil test should be conducted as far in advance of new landscape plantings as possible.**
- **For established turf and plantings, a complete soil test should be conducted every three years and soil pH should be determined annually.**
- **Soil should be tested annually if phosphorous is added.**
- **Soil conditioners, top-dressing materials, composts, and other turf and garden amendments should be tested to ensure suitability for use.**
- **Applying soil-test recommendations, especially recommended nitrogen amounts, must take into consideration Nantucket's thin, sandy soils with the associated risks of nutrient leaching and runoff to vulnerable aquatic resources.**

Soil

The uppermost layer of the earth's crust is referred to as soil. Soil is a mixture of mineral particles derived from underlying rock and organic matter derived from plant and animal residues and includes air and water in the pore spaces. Mineral particles in soil are classified as sand, silt, and clay in descending order of size. The particle size distribution determines soil texture. Soils consisting of approximately 40 % sand, 40 % silt, and 20 % clay are called loams and are generally considered the most appropriate soils for agricultural activities and turf. Soils with a high percentage of clay or sand are generally less suitable for agriculture or turf. Sandy soils, prevalent on Nantucket, are often low in nutrients and organic matter and do not retain water well and are, therefore, a poor base for turfgrasses and many ornamental plantings.

The organic matter [OM] in soil is derived from plants, microorganisms, and animal residues. OM in soil performs several important functions including providing food and habitat for organisms and increasing aeration and moisture-retention capacity. As soil OM decomposes, it releases nutrients that become available for plant uptake, and in that respect it is a form of fertilizer.

Soil structure refers to the aggregation of soil particles into larger sized units. Soil structure results from the physical and chemical activities of plant roots and soil organisms and the seasonal expansion and contraction due to freeze–thaw and wet–dry cycles. A well-structured soil permits air and water movement throughout the root zone, promoting soil health and plant growth. Loam soils tend to be well structured while sand and clay soils tend to be poorly structured. Soil structure is often destroyed by construction activities.

Nantucket's Soil

A range of soil types is found on Nantucket. Although sandy soils are the most common on the island, clays, loams, and mucky organic soils are found in some areas. A typical Nantucket sandy

soil is acidic, low in OM content, nutrient poor, and vulnerable to fertilizer leaching. Because of our poor soils, most lawns, gardens, and other man-made landscapes on Nantucket are dependent on varying degrees of augmentation with fertilizer and/or OM, depending on the type of plantings employed. A comprehensive soil test is recommended to ensure that science-based decisions for nutrient management are made for local soil conditions and the desired plantings.

The Soil Test

The soil test uses physical soil samples taken from a lawn, garden, or other area that are laboratory tested and provide information specific to the area where the samples were collected. A comprehensive soil test provides information on soil nutrients, heavy metals, salinity, pH, buffer pH, cation-exchange capacity (CEC), texture, and percentage of OM.

The soil test provides recommendations for corrective measures for the specified application such as turfgrass or a flower garden. Following the soil-test recommendations, as modified for Nantucket, is an important way to ensure that lawns and gardens are being fertilized correctly. Often, a soil-testing lab will recommend higher amounts of nutrients that are based on traditional crop demands, which can lead to over fertilization on Nantucket soils.

For healthy turf or gardens, a comprehensive soil test is recommended every three to four years. More frequent tests may be required for newly planted areas or in diseased or other problem areas. Soil should be tested annually in areas where compost or other fertilizers containing phosphorus are used to ensure that it is not being over applied. Turf pH should be measured annually, since turf performance and health can be affected by relatively small changes in pH. For new landscape plantings, the soil being used should be tested as far in advance of planting as possible to allow enough time for any recommended adjustments to the soil pH, texture, OM, or nutrient levels to become effective.

Collecting a Proper Soil Sample

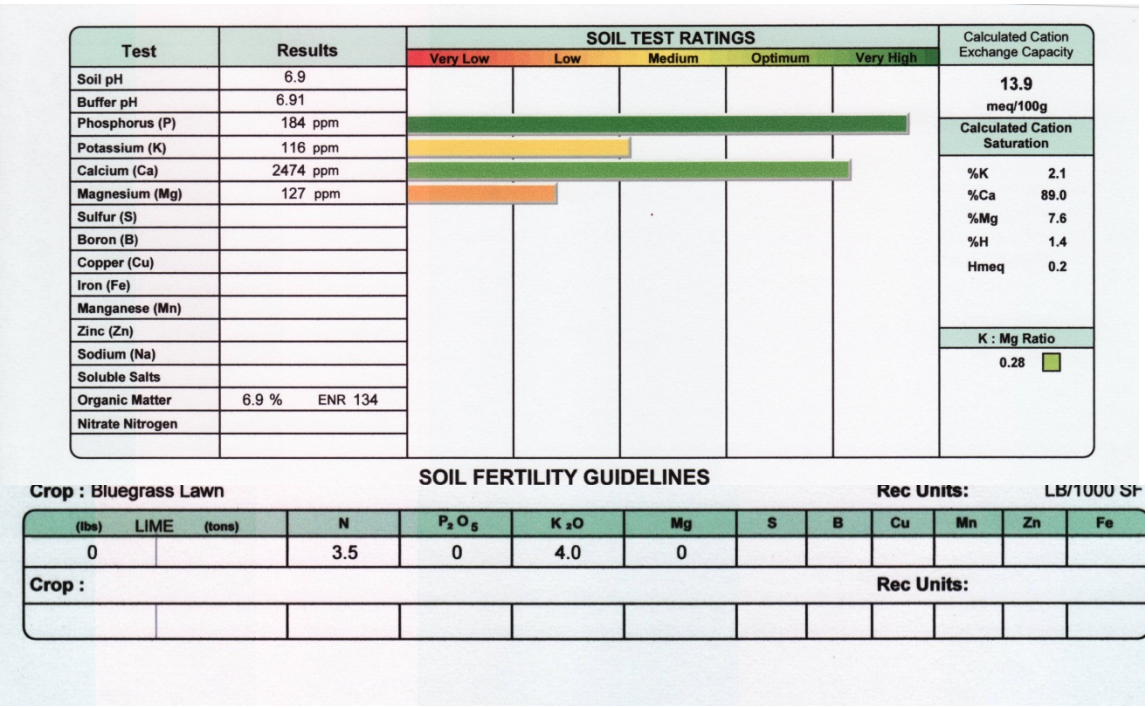
Accurate results and recommendations from a soil-test lab depend on obtaining a good sample. Individual labs provide detailed instructions on collecting, labeling, and submitting samples. [See Appendix 1 for links and mailing instructions for several recommended labs.]

Some tips for obtaining good soil samples follow:

- Use a stainless-steel or chrome-plated soil probe, auger, or trowel. Do not use brass, bronze, or galvanized tools because they may contaminate samples.
- Numerous samples of a representative area should be taken to a depth of 4″ and mixed together. Place one or two cups of the mixed sample into a quart-size sealable plastic bag and label it with property identification and type of use.
- Do not include thatch with soil sample.
- Each sample should represent one use area: e.g., a lawn, a vegetable garden, or a perennial garden.
- Samples may be taken at any time of year but should be at about the same time of the year in successive years. If done at the end of the calendar year, laboratory results will be returned in time for the next growing season.

- For recently limed or fertilized soil, testing should be delayed by eight weeks to allow time for the nutrients to become available.
- Take separate samples for areas showing abnormal plant growth, discoloration, or other cultural problem and for areas that have markedly different soil types.

Figure 1. A Sample Soil-Test Analysis for a Nantucket Soil. *This soil test came from an organically managed lawn where compost was both roto-tilled prior to establishment and subsequently added as top-dressing.*



Test	Results
Soil pH	6.9
Buffer pH	6.91
Phosphorus (P)	184 ppm
Potassium (K)	116 ppm
Calcium (Ca)	2474 ppm
Magnesium (Mg)	127 ppm
Sulfur (S)	
Boron (B)	
Copper (Cu)	
Iron (Fe)	
Manganese (Mn)	
Zinc (Zn)	
Sodium (Na)	
Soluble Salts	
Organic Matter	6.9 % ENR 134
Nitrate Nitrogen	

SOIL FERTILITY GUIDELINES

Crop : Bluegrass Lawn Rec Units: LB/1000 SF

(lbs) LIME (tons)	N	P_2O_5	K_2O	Mg	S	B	Cu	Mn	Zn	Fe
0	3.5	0	4.0	0						

Crop : Rec Units:

Explanation of the Sample Soil Test Analysis
In this sub-section, the components of the soil test in Figure 1 are explained along with the acceptable range of values for each component. Further information on interpreting soil tests can be found in the reference works listed in the Bibliography.

Soil Test Ratings: Individual nutrient elements from this lab are rated with five levels ranging from "very low" to "very high." "Very low," "low," and "medium" levels indicate various levels of deficiency, and specified amounts of the nutrient will be suggested to achieve the correct fertility. An "optimum" level indicates that the correct amount of nutrient is present in the soil. A "very high" level means the nutrient is present in excess of what the plant needs. Nutrients rated as "optimum" or "very high" should not be added to soils, as excess can lead to nutrient losses into ground and surface water.

Soil pH: pH is a measure of soil acidity or alkalinity. A pH of 7.0 is neutral while higher values are alkaline and lower values are acidic. Soil pH affects the plant's ability to absorb nutrients. A pH of 6.0–7.0 is the desired range for most turf and garden plants. This soil test indicates that pH is in the optimum level for a bluegrass lawn.

Phosphorus [P]: Elevated levels of P are a major contributor to freshwater-pond contamination. This test measures P as phosphate [$P_2O_5^+$] that is readily available to plants. In this sample, P measured "very high," so none should be added. As explained in more detail in *Section 5,* two different tests are commonly used to measure P in Nantucket soils: the Mehlich III extraction method and the Modified-Morgan extraction method. These tests give somewhat different results, so the same test procedure should be used when comparing results among years or areas. In this example, the "very high" level of P in the soil may contribute to freshwater nutrient loading if in proximity to any of the island's many freshwater ponds.

Potassium [K]: This test measures available K in a soil. The optimum K level varies with plant, yield, and soil type. A K level of 120–200 PPM is adequate for most plants.

Calcium and magnesium: Calcium deficiencies are rare when the soil pH is adequate. Calcium will be in the optimum range once lime is applied to adjust to the pH-level appropriate for the chosen plants. Magnesium deficiencies are fairly common. Apply dolomitic lime if magnesium levels fall below 70 PPM.

Sulfur: This test shows no ratings for sulfate sulfur, the readily available form of sulfur for most plants. Optimum levels usually range from 20 to 30 PPM.

Micronutrients (zinc, manganese, iron, copper, boron): Turfgrasses need only small amounts of these micronutrients, and deficiencies are uncommon when the pH is below 7.0. For gardens and flowering plants, the optimum range for zinc is 6–10 PPM, manganese is 20–40 PPM, iron is 10–50 PPM, copper is 0.4–5.0 PPM, and boron is 0.8–
2.0 PPM. These levels may be somewhat arbitrary as there are no scientific studies to confirm these levels for turfgrass.

Calculated Cation Saturation: Calculated Cation Saturation provides the relative abundances of the major cations in the soil. Until recently it was thought that there was an ideal balance of cations for maximizing soil fertility. More recent research suggests that the measured levels of the individual cations is more important than relative levels, so this section may provide little useful information.

Sodium: Sodium is a nonessential nutrient for most crops and high sodium levels may cause adverse physical and chemical conditions in soils. Excessive levels of sodium can be reduced by leaching and through the application of calcium sulfate (gypsum).

Soluble Salts: Excessive concentrations of various salts can develop in soils. This may be from natural causes, the result of irrigation with high-salt-content water, excessive fertilizer and compost application, or contamination from chemical or industrial waste. Amounts above 1,900 PPM are hazardous to plants and should be leached from the soil.

Organic Matter [OM]: Organic matter is expressed as a percentage of the total soil mass. It measures the amount of decomposed plant and animal residues in a soil. This soil tests 6.9% OM. Organic matter oxidizes rapidly in sandy soils, such as occur on Nantucket, resulting in

native soils that are low in organic matter. OM at 6.9%, depending on its content, may leach both N and P during oxidation. On un-amended Nantucket soil, organic matter content can be gradually increased to a maximum of 4% OM for both Nantucket turf and gardens by adding leaf-based compost or other organic materials at rates recommended in Section 5: "The Role of Compost in Nantucket Soil"; Section 6: "Guidelines for Timing and Rate of Turfgrass Fertilizer Application"; and Section 9: "Guidelines for Nutrient Management of Gardens, Trees, Shrubs, and Hedges."

Estimated Nitrogen Release [ENR]: The ENR refers to the amount of N measured in pounds per acre that can potentially be released from soil OM during a growing season under ideal conditions. However, the actual rate at which OM will decompose and release N depends on many interrelated factors—soil type, moisture, and temperature having the greatest effects. Most of the soil scientists who were consulted during the preparation of this *BMP* believed that the ENR was not a reliable way to predict N-release rates and at best provides only a snapshot of the potentially available N in a soil.

Calculated Cation Exchange Capacity [CEC]: CEC measures the soil's ability to retain nutrients and other cations such as ammonium, calcium, magnesium, potassium, sodium, and hydrogen. The CEC of a soil increases with the percentage of clay and OM content. The normal CEC value for loamy soil is between 4 and 8. Recent studies indicate 6 as the critical CEC level for turf growth. This test shows excellent CEC capacity.

Crop: The crop is the vegetation or planting type from which the soil sample was collected. The type of crop will affect the amounts of nutrients recommended in the Soil Fertility Guidelines below.

Soil Fertility Guidelines: The soil fertility guidelines list the recommended rates of nutrient applications in pounds per 1000 square feet in order to correct nutrient deficiencies in the soil tested for the crop in question. The recommendation made by this lab for an annual 3.5 lbs. N /1000 sq. ft. exceeds the *BMP* guidelines for Nantucket soils.

Applying the Soil Test Fertility Guidelines to Correct Deficiencies

The example soil test in Figure 1 indicates that N and K are required for this soil and the bluegrass lawn that is present on the site. The recommendation of 3.5 lbs. N / 1000 sq. ft. is greater than allowed on Nantucket. This *BMP* recommends a conservative approach of adding small amounts of N, not to exceed 3 lbs. / 1000 sq. ft. per year, and monitoring plant response to determine overall N need rather that strictly following the soil test guidelines.

The soil test recommends adding 4.0 lbs. K (as K_2O)/1000 sq. ft.; an organic or synthetic source of K may be used. Care must be taken when using a combination product to not over-apply N or P to correct the K deficiency. Only one pound of K can be applied efficiently per application, so the K should be applied in successive applications over the season.

Once application rates for correcting deficiencies are determined, visual inspection of plants for color and vigor and cultural practices should factor into determining a seasonal fertility program for the turf.

Section 4

Fertilizer Types and Sources

- **Fertilizer is a generic term for a material that contains one or more plant mineral nutrients;**
- **Fertilizers may also contain microbial agents.**
- **Nitrogen [N], phosphorus [P], and potassium [K] are the primary nutrients found in fertilizers.**
- **This section discusses the similarities and differences between organic and synthetic fertilizers and between slow- or controlled-release (water insoluble, for the most part) and fast-release (water soluble) nitrogen fertilizers.**
- **Numerous, commonly used natural and synthetic sources and types of N, P and K fertilizers are discussed in an appendix, along with guidelines for their use on Nantucket.**
- **Instructions on how to read and interpret fertilizer labels are provided.**

The numerous types of fertilizers available include granular and liquid, slow- and fast- release, and organic and synthetic formulations. Many fertilizers are blended for specific applications such as turf, ornamentals, or gardens. This section provides information on reading and interpreting a fertilizer label, with particular attention to understanding the sources and types of nitrogen (N) and P present in the fertilizer. Sources and types of K are briefly discussed.

Sources and Types of Nitrogen Fertilizers

Nitrogen Uptake by Plants: N is absorbed by plants in only two forms: nitrate [NO_3^-] and ammonium [NH_4^+]. Other forms of N must be converted to one of those forms to be utilized by plants. Both NO_3^- and NH_4^+ are water soluble, which not only makes them readily available to plants but means they are easily leached from Nantucket's sandy soils.

Both organic and synthetic fertilizers are available with fast- and slow-release forms of N. The N in quick-release fertilizers is water soluble and is usually a salt of either NO_3^- or NH_4^+ or in some form that is readily converted to one of them. Examples of quick-release synthetic fertilizers include ammonium nitrate, potassium nitrate, and urea. Compost tea is an example of an organic fast-release fertilizer.

The N in slow-release fertilizers is not in a readily soluble form. Slow-release synthetic fertilizers rely on a variety of mechanisms—such as coatings—to delay the release of N. Commonly used examples of synthetic slow-release fertilizers include Polyon and Nutralene. Most slow-release organic fertilizers contain N within complex organic molecules that are slowly broken down by soil organisms in a process called mineralization, which releases the N. Compost and Sustane are examples of slow-release organic fertilizers.

The following abbreviations are commonly used in describing the type of nitrogen contained in fertilizer.

SRN – Slow-release nitrogen or slowly available nitrogen. This encompasses many sources of N that are designed to release slowly over time. SRN can be organic, synthetic, or a combination of both. The time required for N release is dependent on the source or chemistry of the individual product (see WIN and CRN below).

WIN – Water-insoluble nitrogen. This is a type of SRN that does not break down by hydrolysis (water), but instead relies on microbial activity for release. It is important to note that microbial activity, and hence the release rate of WIN fertilizers, increases with soil moisture and temperature.

CRN – Coated slow-release nitrogen. CRN fertilizers are synthetic SRN products that employ coatings that dissolve slowly in water or rely on microbial activity to slowly remove the coating. The rate at which the coating is removed varies with the type of product. The N in many CRN products is often water soluble (see WSN below), and once the coating is removed the N is immediately available to plants.

WSN – Water-soluble nitrogen. WSN is quickly released by rain, irrigation, or water in the soil and is immediately available to plants. Large rain events or excessive irrigation just after the application of WSN can result in excessive N leaching or runoff.

Most fertilizers contain a blend of WIN, WSN, and SRN, and the percentage of each is usually indicated on the fertilizer label. Fertilizers used on Nantucket must not contain more than 0.25 lb./1000 sq. ft. of fast-release N, with at least two weeks between applications (see Section 6: "Guidelines for Timing and Rate for Application of Turfgrass Fertilizer"). Total applications can be higher, up to 1.0 lb./1000 sq. ft., but the balance of the N must be in slow-release form.

Recent studies suggest that slow-release fertilizers aren't always effective in reducing N leaching. Nitrogen release from slow-release fertilizers, whether organic or synthetic, does not occur at a steady or predictable rate but varies with some combination of temperature, soil moisture, and microbial activity. The rate of N release also varies among products depending on the form of N and the mechanism employed to control N release. Problems can arise if slow-release fertilizers are applied during a period when environmental conditions do not favor release. The applicator, seeing no response in the turf, may apply additional fertilizer, effectively overloading the soil with N. Large amounts of N can then be released when appropriate conditions return that overwhelm the turf's ability to capture it. In wet years, compared to fast-release fertilizers, slow-release fertilizers are most effective at reducing N leaching, but they may only delay leaching in years of average precipitation.

Whether synthetic or organic, slow or fast release, most of the N applied is eventually released into the soil, and over-application can result in increased fertilizer leaching and runoff. This *BMP* recommends applying both slow- and fast-release fertilizers in several small applications spaced throughout the growing season and monitoring plant performance before applying additional fertilizers. This will help prevent N buildup in the soil and reduce leaching rates (see Section 8: "Guideline for Timing and Rate of Fertilizer Applications").

Phosphorus Uptake by Plants

Phosphorus [P] fertilizers are available in both synthetic- and organic- and fast- and slow- release forms. Although many forms of P exist in soil, it is best absorbed by plant roots as the $H_2PO_4^-$ form of phosphate. P is mined in phosphate-bearing minerals and also occurs as part of many organic molecules. Commonly used fast-release P fertilizers include super triple phosphate,

ammonium phosphate, and potassium phosphate. Commonly used organic P fertilizers include compost, manures (typically as compost), and worm castings. Though composts and manures contain organic forms of P, most of the P found in those sources is inorganic in form. Studies show that up to 85% of P in composted manures can be inorganic. It is important to note that most synthetic and virtually all organic sources of P also contain N; any N additions resulting in addition of P fertilizer must be included in annual N totals.

Phosphorus is relatively immobile in soil and is generally considered not to be prone to leaching in most soil types. However, sandy soils, such as those occurring on Nantucket, are susceptible to P leaching and care must be taken to not over-apply P. It is essential that a soil test be conducted to determine the need for P prior to application (see Section 3: "Soil Nutrient Analysis"). Two phosphorus-extraction methods, the Morgan and the Mehlich III, are commonly used in soil tests. However, these methods provide different P amounts from the same soil sample. Therefore, the same method and testing laboratory should be used for all soil tests on a given property.

Newly established lawns may require readily available P to promote root growth and seedling development (see Section 7: "Turf Establishment Guidelines"). A soil test should be conducted prior to seeding to determine if additional P is required. Research has shown that the inoculation of soil with mycorrhizal fungi at the time of seeding can increase grass-seed germination, seedling establishment, and root growth Mycorrhizal fungi also increase the efficiency of nutrient uptake, including P, and may reduce the need for P during turf establishment.

Sources and Types of Potassium

Though potassium [K] is not a major focus of this *BMP*, its use and application still needs to be made responsibly and in accordance with soil-test results. Sources and types of K fertilizers are included in Appendix 3.

Interpreting the Fertilizer Label

The fertilizer label provides the legal guarantee of the percentage of nutrients contained in the fertilizer. The label contains information on the source and amount of the nutrients and other materials found in the fertilizer, including elemental N, P as phosphate [P_2O_5], and K as potash [K_2O], as well as other nutrients (Figures 3 and 4). The fertilizer ratio compares the percentages by weight of the three major nutrients (N, P, K) contained in the fertilizer. In the sample label in Figure 3, the fertilizer ratio is 8-4-8 or 8% elemental N, 4% phosphate, and 8% potash by weight. The label also describes the chemical sources of the nutrients and the proportion of N as NO_3- and NH_4+, as well as the percentage of slow-release N in the fertilizer.

Figure 3. *A sample fertilizer label*

GUARANTEED ANALYSIS **8-4-8**
Plus Minors

Total Nitrogen (N) 8.0%
5.56% Ammoniacal Nitrogen
2.44% Urea Nitrogen*
Available Phosphate (P_2O_5) 4.0%
Soluble Potash (K_2O) 8.0%
Total Magnesium (Mg) 1.2%
1.2% Water Soluble Magnesium (Mg)
Sulfur (S) 7.0%
7.0% Combined Sulfur (S)
Boron (B) 0.02%
Total Copper (Cu) 0.05%
0.01% Water Soluble Copper (Cu)
Total Iron (Fe) 1.5%
0.1% Water Soluble Iron (Fe)
Total Manganese (Mn) 1.4%
0.01% Water Soluble Manganese (Mn)
Molybdenum (Mo) 0.0005%
Total Zinc (Zn) 0.05%
0.01% Water Soluble Zinc (Zn)

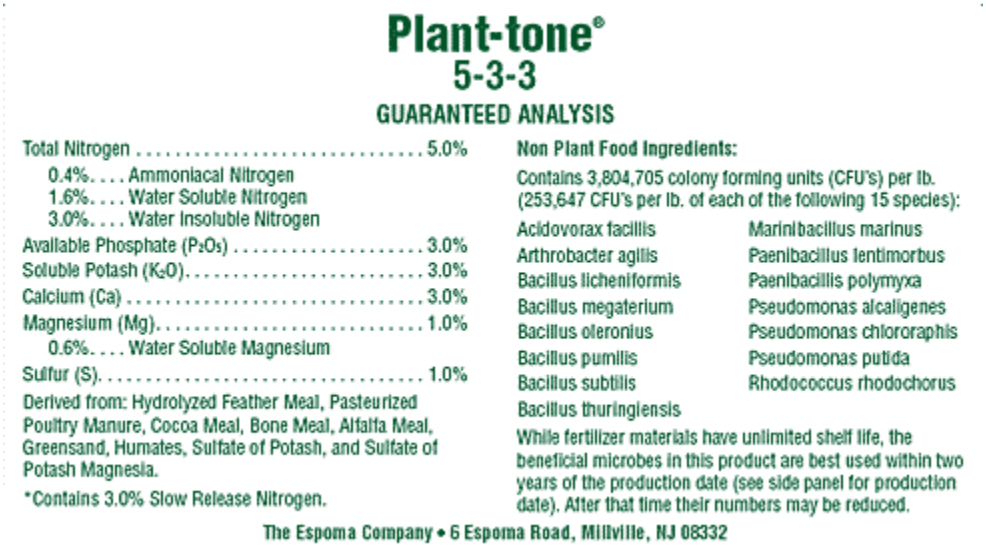
Derived from: Polymer-coated Urea, Urea, Diammonium Phosphate, Sulfate of Potash Magnesia, Muriate of Potash, Sodium Borate, Copper Sulfate, Copper Oxide, Ferrous Sulfate, Ferric Oxide, Manganese Sulfate, Manganese Oxide, Molybdic Oxide, Zinc Sulfate and Zinc Oxide.

*Contains 2.1% slowly available nitrogen from coated urea.

F1074

Some fertilizers also provide information on micronutrients and non-plant food ingredient content and the amounts and types of beneficial microbes in the product, as indicated in the label in Figure 4.

Figure 4. *A fertilizer label including information on non-nutritive ingredients.*



Plant-tone®
5-3-3
GUARANTEED ANALYSIS

Total Nitrogen 5.0%
0.4%.... Ammoniacal Nitrogen
1.6%.... Water Soluble Nitrogen
3.0%.... Water Insoluble Nitrogen
Available Phosphate (P_2O_5) 3.0%
Soluble Potash (K_2O) 3.0%
Calcium (Ca) 3.0%
Magnesium (Mg) 1.0%
0.6%.... Water Soluble Magnesium
Sulfur (S) 1.0%

Derived from: Hydrolyzed Feather Meal, Pasteurized Poultry Manure, Cocoa Meal, Bone Meal, Alfalfa Meal, Greensand, Humates, Sulfate of Potash, and Sulfate of Potash Magnesia.

*Contains 3.0% Slow Release Nitrogen.

Non Plant Food Ingredients:

Contains 3,804,705 colony forming units (CFU's) per lb. (253,647 CFU's per lb. of each of the following 15 species):

Acidovorax facilis
Arthrobacter agilis
Bacillus licheniformis
Bacillus megaterium
Bacillus oleronius
Bacillus pumilis
Bacillus subtilis
Bacillus thuringiensis
Marinibacillus marinus
Paenibacillus lentimorbus
Paenibacillis polymyxa
Pseudomonas alcaligenes
Pseudomonas chlororaphis
Pseudomonas putida
Rhodococcus rhodochorus

While fertilizer materials have unlimited shelf life, the beneficial microbes in this product are best used within two years of the production date (see side panel for production date). After that time their numbers may be reduced.

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Always consult a soil test when determining the proper fertilizer for the soil in question. Soil tests are discussed in detail in Section 3: "Soil Nutrient Analysis: The Importance of the Soil Test." [See Section 6: "Guidelines for Timing and Rates of Turfgrass Fertilizer Application" for detailed information concerning fertilizer application rates.] See Appendix 3 for a detailed description of nitrogen fertilizers.

Section 5

The Role of Compost

- **Composts and compost teas are considered fertilizers for the purposes of the Nantucket *BMP***
- **Composts are derived from a wide range of sources and must be tested for nitrogen [N] and phosphorus [P] content, soluble salts, and pH before being applied for landscape purposes. Testing for heavy metals is also recommended if the source of the compost is unknown.**
- **Composts are sources of nutrients, increase soil organic matter[OM] and aeration, provide food for beneficial bacteria and fungi, and improve soil-water and nutrient-holding capacity.**
- **Due to its low N and P content, compost derived from leaf litter is preferred for Nantucket soils.**
- **Compost should be applied only between April 15 and October 15 and when soil temperatures are above 55^{o}F.**
- **For soils testing at optimum P levels, a maximum annual rate of ½ inch of leaf-based compost is allowed applied in two ¼ inch applications with a minimum of three months between applications.**
- **Composts made from feedlot and dairy manure contain relatively high levels of both N and P and should be applied only if a soil test indicates severe P deficiencies and at rates recommended for Nantucket's soils.**
- **Composts made from poultry manure are not recommended because they contain high levels of N and P and can contain elevated levels of soluble salts.**
- **Compost tea is an aqueous extract of compost that is used as a foliar fertilizer and as a means of inoculating soil with beneficial microorganisms. The latter claim has not been scientifically verified.**
- **The maximum organic matter [OM] percentage recommended for sandy Nantucket lawns and gardens soils is 4%. It is difficult to increase the OM content of soils more than 1% above the native OM content without increasing soil test P values above the Environmental Critical Level [ECL].**

Compost

Compost is partially decomposed organic matter that can be produced from plant material, animal waste, or both. Compost is commercially available in bulk or bags for the landscape trade and can also be produced at home. Compost performs several important functions for lawns, gardens, and ornamental plantings. This section will discuss compost as a means of increasing soil OM content, increasing the number and diversity of soil organisms, and as a fertilizer. All composts used as soil amendments on Nantucket must have a known nutrient content or be tested for nutrient content before use.

Compost and Soil Organic Matter Content

Compost is often added to soil to increase OM content. Soil OM improves soil structure, aeration, water- and nutrient-holding capacity, biological activity, and fertility. As soil OM decomposes, nutrients are released and made available to plants. The decomposition rate depends on a variety of factors including soil moisture, aeration, temperature, biological activity, and the type of compost used. Although the precise decomposition rate is difficult to predict accurately, it tends to be high in sandy soils.

The generally prescribed range of OM for turf, gardens, and crop soil is between 5 and 8%. Nantucket's native sandy soils tend to have much lower OM content, ranging from 0.8 to 3.5 %. It is difficult to increase soil OM content more that 1% above the native OM content without increasing the likelihood of nutrient leaching. Therefore, a maximum soil OM level of 4% is recommended for Nantucket soils used for turf, gardens, or ornamental plantings. Increases in soil OM should occur slowly over several years and include monitoring of soil test P levels to ensure the Environmental Critical Level [ECL] for P is not exceeded. Adding additional amounts

of OM increases the risk of excessive nutrient application and nutrient loss to leaching or runoff. The process of using soil test P values to limit additions of compost to soils, and hence the soil OM content, is discussed in more detail in "Compost Phosphorus Content," below, and was arrived at after consultation with several of the turf- and soil-science professionals who reviewed the *BMP* (see Bibliography).

Compost and Soil Organisms

Soil OM, whether from compost or other sources, provides food and habitat for a complex array of soil organisms including bacteria, fungi, microorganisms, worms and insects. Soil organisms increase soil aeration and water infiltration and, in some cases, help prevent or reduce the severity of plant diseases. Soils with a diverse array of native organisms are often referred to as "healthy soils." Soil organisms are largely responsible for the decomposition of soil OM, which releases nutrients and makes them available to plants.

Compost as a Fertilizer

The *BMP* considers compost to be a fertilizer because it contains varying amounts of N, P, K, and other nutrients, depending on its source (Table 1). While the nutrient concentration of most composts is lower than that found in most granular fertilizers, much larger amounts of compost are often added to soils compared to fertilizers, so care must be taken to avoid over-applying compost. Leaf-litter compost tends to be the lowest in P and N and is the preferred compost for use on Nantucket. Manure, lawn, garden, and food-waste composts contain much higher levels of N and P. Some manure-based composts, especially poultry-manure compost, contain excessive amounts of soluble salt. Manure-based composts should not be used on Nantucket unless a soil test indicates otherwise.

Table 1. *Typical percentages of N and P in compost from various sources*

Compost Type	%N	%P
Leaf litter	0.1	0.05–0.2
Horse manure	0.5–1.5	0.5–1.5
Lawn, garden, and food waste	1.0–1.5	1.0–1.5
Dairy manure	1.0–1.5	1.0–1.5
Feedlot manure	1.0–1.5	1.0–1.5
Poultry manure	1.5–2.0	1.5–2.5

Compost Phosphorus Content

All currently available composts contain P in amounts that may result in over-application of P if applied at commonly recommended rates. This *BMP* recommends compost application rates based on soil and compost P content and on the Agronomic Critical Level [ACL] and Environmental Critical Level [ECL] of P in an effort to ensure that soil P levels do not exceed recommended amounts. The ACL is the soil P level at which an adequate amount of P is present

for crop or turf production. The recommended P application rate in the soil-test report is designed to bring the soil P concentration above the ACL. The ECL is the soil P level at which P will run off or leach from the soil in amounts that can cause environmental damage. In general, the ECL is higher than the ACL, but the difference may be small, especially in sandy soils (Table 2). This results in a small margin of error when applying P in sandy soils.

Soil-testing laboratories in the Northeast typically use either a Modified-Morgan or the Mehlich III extraction method to determine soil P levels. These tests use different extraction solutions and produce very different results, so it is critical that applicators know which extraction solution was used. This information is provided in the soil-test report. It is important for applicators to use the same soil-testing laboratory and extraction method for repeated soil testing on a given property so that values can be compared. The ACL and ECL for a typical sandy soil such as those that commonly occur on Nantucket are presented in Table 2. The ECL for Nantucket's soils was arrived at from recent research on sand soils and after consultation with several of the turf-science professionals who reviewed the *BMP* (see bibliography).

Table 2. *The Agronomic and Environmental Critical Concentrations for Sandy Soils for the Modified Morgan and Mehlich III extraction methods.*

Extraction Method	Agronomic Critical Level	Environmental Critical Level
Modified Morgan	6 PPM or 12 lbs./acre	14 PPM or 28 lbs./acre
Mehlich III	50 PPM or 100 lbs./acre	150 PPM or 300 lbs./acre

PPM = parts per million.

Guidelines for Compost Application Based on Compost P Content

The average P concentrations of various types of compost are shown in Table 3. Most manure-based composts contain high concentrations of P. Up to 85% of the P in manure composts may be in fast-release inorganic form. Manure-based composts should be applied only if a soil test indicates a P deficiency. Even small applications of manure-based composts—for example, application of 1 inch of a 1% P_2O_5 concentration compost—may cause soils to exceed the ECL. In general, only leaf-based composts contain P in sufficiently low concentrations to prevent over-application of P. *Only leaf-based composts should be used on Nantucket.*

A routine soil test should be conducted before applying compost or any fertilizer. No P should be added to soils that are at or above the ACL. For soils that test below the ACL, apply the amount of P_2O_5 recommended in the soil-test report. It may be difficult to apply the amount of P_2O_5 recommended in a soil test report when using compost to maintain fertility. For example, recommended application rates for soils that test low for P often are in the range of 1 to 2 lbs./1000 sq. ft. Only ⅛ inch of a compost with a P_2O_5 concentration of 0.5% (e.g. leaf-based compost) will be needed because it supplies about 1.6 lbs. P_2O_5/1000 sq. ft. However, a ⅛ inch of compost with a P_2O_5 concentration of 1.0% (e.g. manure-based compost) would apply 3.1 lbs. of P_2O_5/1000 sq. ft., which is greater than the recommended amount. An additional soil test should be conducted before another application of P is made.

Soils that test between the ACL and the ECL for P can receive applications of compost if needed

for improving soil quality and/or OM content, but such applications are discouraged. Application of a maximum of a quarter-inch of leaf-based compost is recommended for these soils. Applicators should wait at least three months and conduct a soil test before applying additional compost to these soils to ensure that the soil-test level does not exceed the ECL. Additional applications should not exceed one-quarter inch. No more than one-half inch of compost should be applied annually when a soil test shows P is at or above the ALC, and no compost should be added when the soil test P level is at or above the ECL.

The above guidelines apply to turf, trees, shrubs, and gardens and to both new plantings and established landscapes. [See Section 7: "Guidelines for Establishment and Renovation of Turfgrass"; Section 8: "Cultural Practices for Turf Care"; and Section 9: "Guidelines for Establishment and Fertility of Ornamental Gardens, Trees, Shrubs, and Hedges" for detailed establishment, maintenance, and renovation practices.]

Table 3. *Total pounds of phosphate [P_2O_5] applied /1000 sq. ft. in composts with various percentages of P concentration and at various application rates. See Table 1 for the percentage of P in various types of compost.*

Application rate			Percent P_2O_5 in Compost					
Depth Inches	**Yd³/ Acre***	**Tons/ Acre**	**.05%**	**0.5%**	**1%**	**1.5**	**2%**	**2.5%**
			Pounds phosphate [P_2O_5] applied per 1000 sq. ft.					
1/8	**16.9**	**6.8**	0.16	1.6	3.1	4.7	6.2	7.8
¼	**33.8**	**13.5**	0.3	3.1	6.2	9.3	12.4	15.5
½	**67.5**	**27.0**	0.6	6.2	12.4	18.6	24.8	31.0
1	**135.0**	**54.0**	1.2	12.4	24.8	37.2	49.6	62.0
2	**270.0**	**108.0**	2.5	24.8	49.6	74.4	99.2	124.0

***Based on an average compost weight of 800 lb./cubic yard (wet weight)**

Compost Nitrogen Content

Although these *BMP* guidelines for compost application are based on P content, attention must also be paid to the amount of N applied in compost. Table 4 provides estimates of total lbs. of N per 1000 sq. ft. contained in various types of compost. Nitrogen in compost is slowly released as the compost decomposes. Approximately 10 to 25% of the N is mineralized and released during a one-year period, although the release rate is likely near the 25% rate on sandy soils. Therefore, a compost application containing 12 lbs. N/1000 sq. ft. would be expected to release about 3 lbs.

N/1000 sq. ft. during the first year, which is the maximum allowed by the *BMP*. However, adding this much of any compost would supply about 12 lbs P_2O_5/1000 sq. ft. and would overload the soil with P. Therefore, it may not always be possible to achieve the desired annual N release rate using only compost, and organic landscape practitioners may need to supplement compost with organic fertilizers that contain no P.

Since only a portion of the compost decomposes each year, much of it remains in the soil for several years. Repeated compost applications may overload the soil with N and increase the possibility of nitrate loss to leaching or runoff.

Table 4. *Total pounds of N applied per 1000 sq. ft. in composts with various percentages of N composition and at various application rates. See Table 1 for the percentage of N in various types of compost. The application rate is presented with three different measurements, but the actual application amount in a row is the same for each measurement.*

Application Rates			**Percent Nitrogen in Compost**					
Depth Inches	**Yd/ Acre***	**Tons/ Acre**	**0.1%**	**0.5%**	**1%**	**1.5**	**2%**	**2.5%**
1/8	**16.9**	**6.8**	0.3	1.6	3.1	4.7	6.2	7.8
¼	**33.8**	**13.5**	0.6	3.1	6.2	9.3	12.4	15.5
½	**67.5**	**27**	1.2	6.2	12.4	18.6	24.8	31.0
1	**135**	**54**	2.5	12.4	24.8	37.2	49.6	62.0
2	**270**	**108**	5.0	24.8	49.6	74.4	99.2	124.0

Adapted from the Composting Council, University of Missouri Extension
***Based on an average compost weight of 800 lb./cubic yard (wet weight)**

Compost Tea

Compost tea is a fertilizer and soil amendment made by steeping well-aged compost plus a variety of nutrients and supplements in oxygenated water. The microorganisms and nutrient content of compost tea can vary widely, depending on brewing methods. Compost tea contains fast release N, P, and other nutrients, and it should be tested for nutrient content before application. Compost tea also contains a variety of microorganisms that are believed to be beneficial to soil health, though this assertion has not been scientifically established. It is also important to test compost tea for human pathogenic bacteria that may develop during the brewing process. Additional information on compost tea can be found in Section 6: "Guidelines for Timing and Rate for Application of Turfgrass Fertilizer.

Section 6

Guidelines for Timing and Rates for Application of Turfgrass Fertilizer

- **Effective and safe turf fertilizer use depends on correct application rates and timing.**
- **A soil test analysis should be consulted for making informed fertilizer application decisions.**
- **Fertilizer, both synthetic and organic, including composts, should only be applied on Nantucket after April 15 and before October 15 and when soil temperatures are above 55° F.**
- **Fertilizers should not be applied before a heavy rain and irrigation after application is limited to moistening the root zone.**
- **The maximum nitrogen [N] application rate for lawns on Nantucket is 3 lbs. N/1000 /sq. ft. /year.**
- **No individual N application shall exceed 1 lb. N/1000 sq. ft**.
- **No individual N application shall contain more than .25 lbs fast-release N/1000 sq. ft.**
- **Timing for N applications intervals depends on the amount of N per application and should never be less than two weeks apart.**
- **Observation of turf color and vigor should help guide application intervals over the course of the growing season.**
- **Phosphorus [P] should not be applied unless a soil test indicates a deficiency. Detailed exceptions are made for compost.**
- **Spoon-feeding of smaller amounts of fertilizer at more frequent intervals is often the most efficient and safe way to fertilize, but may not be realistic for most applicators or homeowners.**
- **Three sample fertility programs are detailed for an organic approach, a synthetic approach, and a hybrid (combined organic and synthetic) approach for annual turf fertilization.**

Timing

The proper timing and rate of fertilizer application are important for both meeting plant requirements and avoiding nutrient contamination of aquatic resources. Turfgrass does not efficiently utilize nitrogen [N] or [P] when the ground temperature is below 55^{o} F or during very hot or dry conditions. Applying fertilizer at times when it is not available to plants can lead to surface runoff into wetlands or leaching into groundwater. Fertilizers should be applied only between April 15 and October 15 and when soil temperatures are above 55° F. Soil temperatures can be measured at a four-inch depth with a simple, inexpensive soil thermometer. Special precaution should be taken for fertilizer applications at either end of the growing season when plant uptake rates may be slow. Visual examination of turf health and vigor is an important component for the assessment of fertilizer needs.

Application Rates

The total amount of N applied to turf should not exceed 3 lbs.N/1000 sq. ft. per year. P should be applied to turf only if a soil test indicates a P deficiency. Detailed exceptions are made for compost, as described in Section 5: "The Role of Compost."

Applying fertilizer in smaller amounts, spaced over the growing season, is the safest way to reduce the likelihood of fertilizer runoff or leaching. This *BMP* recommends application rates of 0.5 lb N/1000 sq. ft. per application and no more than 1 lb. N/1000 sq. ft. per application. At least a two-week interval between applications should be maintained if applying at a rate of 0.5 lb N/1000 sq ft. At the rate of 0.75 lb N/1000 sq ft, the interval between applications should be a minimum of three weeks. And any applications of 1 lb N/1000 sq. ft. should not be repeated for at least four weeks. Always observe and assess plant vigor to determine the need for fertilizer prior to applications.

Fertilizer applications may continue throughout the summer as long as sufficient soil moisture is available. Application intervals should be extended or applications terminated during periods of drought unless supplemental water is provided. Most of the N applied in early fall will be utilized for root growth instead of shoot growth and helps prepare the turf for surviving winter conditions.

Care must be taken when applying slow-release N fertilizers to avoid N build up in the soil. When applying slow release N, particularly in the spring when soil temperatures are low, a product that releases a portion of its N quickly is recommended. Slow-release forms of N, which are dependent on microbial activity for availability, may require higher soil temperatures than are typical for Nantucket's spring.

Soil OM and the amount of stored N in the soil increases as lawns mature and can reach a maximum between 10 and 25 years of age. A sufficient amount of soil N for plant growth may be present in soil OM in mature lawns so that they require little to no application of N. Application of even small amounts of fertilizer to mature lawns can increase the risk of N leaching. Careful visual inspection of plant performance can help reduce fertilizer rates on mature lawns.

Leaving clippings while mowing can provide up to 33 % of the N required for turf fertility. Leaving clippings is encouraged, and the amount of N in the clippings must be factored into calculating annual N inputs. For example, if a lawn requires 3 lbs. N/1000 sq. ft. and clippings are recycled, the annual amount of N fertilizer applied should decrease to 2 lbs.N/1000 sq. ft.

Table 5 *Fertilizer Application Guidance for Turfgrass*

Timing	Apply only between April 15 and October 15
Interval	Maintain intervals of two weeks or more between applications. Lengthen intervals if applying more than 0.5 lb. N/1000 sq. ft. at any one time.
Total annual application	No more than 3.0 lb N/1000 sq ft. No P unless a P deficiency is identified by a soil test (certain exemptions for compost).
Individual application amount	Less than 0.5 lb. N/1000 sq. ft. per application is preferred. No more than 1.0 lb. N/1000 sq. ft. is allowed per application. If a total 3.0 lbs. N is applied at rates of 0.5 lb. N/1000 sq. ft., this implies six applications over no less than twelve weeks. If all 3.0 lbs. are applied at 1.0 lb. N/1000 sq. ft., this implies three applications over no less than twelve weeks.
Fertilizer release type	During times of rapid growth and fertilizer uptake, up to 0.25 lb. N/1000 sq. ft. of fast-release fertilizer may be used in an application. The balance must be slow-release fertilizer.
Fertilizer source	This guidance is based on the turf's need for N. Either organic or synthetic fertilizers may be used.

Applying Compost as a Fertilizer
Compost types, sources, and guidelines for application are described in Section 5. Compost is generally applied to increase the amount of organic matter [OM] found in Nantucket's native sandy soils, which average between 0.8 and 3.5 %, and rarely exceed 3.5 % OM. Compost is also a source of nutrients and is considered a fertilizer on Nantucket. The nutrient content of composts varies widely depending on its source material (see Section 5). Leaf-based composts are relatively low in both N and P and are the best sources for increasing soil organic matter while minimizing N and P inputs. Composts derived from animal manures are relatively high in both N and P and some are not suitable for use on Nantucket. Poultry manure can be very high in N, P, and sodium and is not recommended unless diluted with a low N and P compost.

The nutrient content of compost must be determined prior to application in order to avoid applying excess N or P. Most forms of P in compost are in readily available forms and the application of even modest amounts of high-P composts, such as animal-manure composts, can result in excessive amounts of P being added to the soil. Leaf-based composts, are low in P and are the recommended composts for use on Nantucket. Compost containing P should only be applied when a soil test identifies a P deficiency. Detailed exceptions to this rule are explained in Section 5.

Nitrogen is slowly released as compost decomposes, and is made available for plant growth. The N release rate varies with soil temperatures, precipitation, and bacterial activity. As a general rule for compost, between 10 and 25 % of the total N applied is released on an annual basis. The remaining N is released in subsequent years as the compost continues to break down. As new applications are made in later years, it is necessary to estimate the amount of nitrogen that may become available from previous applications. This will help to avoid N building up to levels that may result in leaching or runoff.

For detailed information related to compost sources, nutrient content, and appropriate application rates, see section 5.

Spoon-Feeding
Spoon-feeding is the practice of applying small amounts of water-soluble fertilizer as often as every two weeks during the growing season. The small amounts of fertilizer applied are designed to meet the plants immediate needs so little is lost to leaching or runoff. Although many applications are made, the individual amounts applied are so small that the annual total applied is often considerably less than achieved with other application methods. Disadvantages to spoon-feeding include the need to closely monitor the plants in the application area and the time required for multiple applications. Granular fertilizers with sufficiently low nutrient concentrations for spoon-feeding may not be readily available so liquid fertilizers are generally used.

Biweekly application rates when spoon-feeding turf with N can be as low as 0.10–0.25 lbs.N/1000 sq. ft. Do not exceed 0.25 lbs. of N per 1,000 sq ft for any one application.

Foliar-Feeding
Foliar fertilizing is one type of spoon-feeding. For the Nantucket *BMP,* foliar fertilizers are

defined as any fertilizer designed for uptake into a plant through its leaves rather than through its roots. Foliar fertilizers are typically liquids containing low concentrations of nutrients that are sprayed directly on the foliage of the plant. As with other products designed for spoon-feeding, the nutrients in foliar fertilizers must be fast release to ensure rapid uptake by the plants.

Spreader Calibration
Correct application rates for turf fertilizers are dependent on correctly calibrated spreaders. Fertilizer spreaders should be calibrated annually and should be recalibrated when using different products. Detailed step-by-step instructions for spreader calibration are included in Appendix 4.

The Weather Factor
Large rainfall events or excessive irrigation coupled with improper fertilizer applications are major contributors to surface runoff and leaching of fertilizers. A weather forecast should be consulted prior to any fertilizer application. Fertilizer applications that contain N or P should not be made if a weather forecast predicts more than ½″of rain, or intense rain of any amount, such as during a thunderstorm is predicted within 7 days following application.

Watering and Irrigation
The amount of water applied with irrigation systems or sprinklers following fertilizer applications should be limited to less than ½″ per application for seven days following fertilizer application to avoid fertilizer loss via runoff or leaching. This is an average value that will vary with soil type, weather, and other site conditions. In general, only the amount of water required to moisten soil to the bottom of the root zone should be applied. A soil-moisture probe can be used to determine the depth of soil moisture for adjusting irrigation. "Watering-in" is a technique used to begin the breakdown of water-soluble N or for any slow-release N that depends on hydrolysis for release. Watering-in can also reduce N loss from volatilization and can decrease the risk of runoff. Between 1/10″ and 1⁄4″ of rain or irrigation is sufficient for the watering-in of fertilizer.

Special Care and Clean-Up
Care should be taken when applying fertilizers to make sure that wetlands and other water resources are not at risk from improper applications. Any fertilizer that spills or is spread on a sidewalk, driveway, or other impervious surface should be swept up and added back to the bag or the spreader. Exposed storm-water drains should be covered with a small tarp or plywood to prevent fertilizer from falling into the drains. Any fertilizer remaining on the plywood or tarp should be added back to the bag or spreader.

Record Keeping
Keeping proper records of fertilizer applications is necessary to track the amount of nutrients applied over a season. Record keeping also allows applicators to compare actual amounts with predicted results and helps to refine future fertilizer programs. A sample sheet for record keeping is included in Appendix 3.

Three Sample Turf Fertilizer Management Programs
Three sample annual turf fertilizer programs, one using only organic fertilizers, one using primarily synthetic fertilizers, and one designed for spoon feeding are provided as guidelines for

turf fertilizer application rates and timing. As always, a soil test analysis forms the basis for nutrient management.

An Organic Fertility Program
This program is designed for renovation of a homeowner-maintained lawn that is underperforming. The soil-analysis identified pH at 5.3, "optimum" P content, "very low" K content, "low" magnesium [Mg] and OM at 3.4 %.

First application: Apply dolomitic limestone as indicated by the soil test at rates up to 50 lbs./1000 sq. ft. to raise pH and improve Mg levels in late fall of the previous season, when possible, as lime takes up to six months to alter pH.

Second application: As soil temperatures reach 55° F in spring (late April to mid-May), apply natural sulfate of potash (0-0-50) at 1 lb./1000 sq. ft. of K_2O to improve K levels. Apply sulfate of potash, magnesia at 0.5 lb./1000 sq. ft. of K_2O to improve K, Mg, and sulfur. Alternatively, use dolomitic limestone in the step above to alter Mg content if needed. Top-dress with leaf-litter compost at a ⅛″depth to increase the soil's OM level, supply a small amount of N (0.3 lbs N/1000 sq. ft.) and increase soil microbiology.

Third application, June 15. Apply an organic fertilizer blend of 6-0-6, at the rate of 1 lb. N/1000 sq. ft. A typical organic blend of 6-0-6 is made from sulfate of potash, natural nitrate of soda, peanut meal, feather meal, and pasteurized poultry litter. 75% of the N is water insoluble, or slow release.

Fourth application, July 15. Apply compost tea to supply beneficial microorganisms, micro elements, and less than 0.1 lb. N/1000 sq. ft.

Fifth application, Aug 15. Apply compost tea to supply beneficial microorganisms, micro elements, and less than 0.1 lb. N/1000 sq. ft.

Sixth application, Sept 1. Top-dress with leaf-litter compost at a 1⁄8″ depth to increase soil OM, N (est. 0.3 lb. N/1000 sq. ft.) and microbiology. Combine this application with aeration and over seeding to increase turf density.

Seventh application, Sept 15. Apply the 6-0-6 organic blend as described in the Third Appliction, at a rate of 1 lb. N/1000 sq. ft.
Eighth application, Oct 1. If the need is indicated by a subsequent soil test, apply natural sulfate of potash (0-0-50) at a rate of 1 lb. K/1000 sq. ft. K_2O to improve K levels.

Totals for the season:
N – 2.8 lb./1000 sq. ft.
P (from leaf-based compost) – 0.45 lbs P_2O_5/1000 sq. ft.
K – 4.5 lbs. K_2O/1000 sq. ft.
Sulfur – 0.5 lb./1000 sq. ft.
Mg – 0.5 lb per 1000 sq ft.

A Program for (Primarily) Synthetic Turf Fertilizer
The following program consists of products that contain primarily synthetic sources of N. It presumes a relatively healthy irrigated turf with sufficient phosphorus available in the soil.

First application, late fall of previous season. Application of dolomitic limestone at 50 lbs./1000 sq. ft. to raise pH and improve Mg levels in late fall of the previous season, if possible, as lime takes up to six months to alter pH

Second application, May 15. Apply 30-0-7 with 75% slow-release N, at a rate of 1 lb. actual N/1000 sq. ft.

Third application, July 1. Apply (15-0-8) an organic/synthetic bridge product with 92% slow-release N, at a rate of 1 lb. actual N/1000 sq. ft.

Fourth application, Aug 15. Apply a synthetic fertilizer (29-0-10) with 70 % slow-release N at the rate of 0.5 lb. actual N/1000 sq. ft.

Fifth application, *Oct 1.* Apply (15-0-8) an organic/synthetic bridge product at the rate of 0.5 lb. actual N/1000 sq. ft.

Totals for the season:
N – 3.00 lbs./1000 sq. ft., 83% of which is slow release and 40% organic
P – 0.0 lbs.P_2O_5 /1000 sq. ft.
K– 1.2 lbs. K_2O/1000 sq. ft.

Hybrid Fertilizer Program – Spoon-Feeding
The following turf-fertility program consists of products that contain both organic and synthetic sources of N. The assumption is that P levels are optimum, as indicated by a soil test, and that K is deficient. Some of these products below are "bridge products" that contain both organic and synthetic materials. This program emphasizes the spoon-feeding of N.

First application, May 14. Apply 6-0-12, at a rate of 0.24 lb. N/1000 sq. ft., 100% fast release. Also contains manganese sulfate (which will provide enhanced green color similar to iron sulfate) and magnesium sulfate to increase Mg levels.

Second application, June 4. Apply 12-0-12, 0.48 lb.N/1000 sq. ft., 50% slow release. This fertilizer is a bridge product that is 50% organic and 50% synthetic. Urea and methylene urea (slow release) make up the synthetic portion of this product. Organic sources of N include kelp meal, fish meal, crab meal, alfalfa meal, poultry meal, and blood meal. These sources include fast- and slow-release sources of N. A small amount of P is included in this product. It also contains ferrous sulfate for color and magnesium sulfate to increase Mg levels.

Third application, July 2. Apply 12-0-12, 0.48 lb.N/1000 sq. ft., 50% slow release.

Fourth application, Aug 6. Apply12-0-12, 0.48 lb.N/1000 sq. ft., 50% slow release.

Fifth application, Sept 3. Apply 6-0-12, 0.24 lb N/1000 sq. ft., 100% quick release.

Sixth application, Sept 24. Apply 6-0-12, 0.24 lb.N/1000 sq. ft., 100% quick release.

Totals for season:
N – 2.16 lbs. /1000 sq. ft., 33% of which is slow release, 33% organic
P – 0.0 lbs. P_2O_5 /1000 sq. ft.
K – 2.88 lbs. K_2O/1000 sq. ft.

Section 7

Guidelines for Establishment and Renovation of Turfgrass

- **Detailed steps are provided for establishing a lawn from seed or sod and for renovating a damaged or underperforming lawn.**
- **A soil test should be conducted to provide the basis for determining and correcting nutrient and other soil deficiencies during establishment or renovation.**
- **Phosphorus should only be applied if a soil test indicates a deficiency.**
- **Use of certified seed and pre-germination of seed are recommended.**
- **Careful monitoring of soil moisture and appropriate watering practices will improve seed germination and establishment.**
- **Recommendations for follow-up fertilization and mowing timing and height are provided.**
- **Numerous species, cultivars, blends, and mixes of grasses appropriate for use on Nantucket are provided.**
- **Species and cultivar selection is discussed based on intended use, soil, and other environmental conditions and degree of intended maintenance. A mix of species or a blend of cultivars is preferable for most uses.**
- **A mix of fine fescue species is recommended for low-maintenance lawns requiring reduced water and fertilizer inputs.**

Many of the principles for establishing and renovating lawns are the same as for maintaining them. Special care needs to be taken when establishing a lawn to avoid the runoff or leaching of fertilizers applied to bare or sparsely vegetated soil. The following guidelines will help ensure both successful turf establishment and protection of our water resources from nutrient contamination.

Late summer or early fall is the preferred time to establish or renovate a lawn on Nantucket. During these times, soil temperatures are still warm, there is plenty of sun, and moisture is available for maximum seed germination. This starting time allows for sufficient root and shoot development for plants to survive the winter. Establishing a lawn in the spring or summer almost always requires more water and fertilizer and may require herbicides to control competition from spring germinating weeds. Sod should be considered as an alterative to seed when establishing a lawn in spring or summer.

Establishing a Lawn from Seed: A Step-by-Step Guide

1. *Obtain a soil test.* A comprehensive soil test is recommended that includes, at minimum, the following: phosphorus [P], potassium [K], pH, and percent organic matter [OM]. Nutrients should only be added if the soil test indicates a deficiency. See Section 3: "Soil Nutrient Analysis: The Role of the Soil Test" for more information on obtaining and applying a soil test.

2. *Rough grade the site.* Remove stumps, large rocks, and debris. Smooth the surface and finish grade to achieve a desired surface drainage pattern. Grade so that water drains away from structures and does not pool.

3. *Amend the soil based on the soil-test analysis to achieve a maximum 4" – 6" of topsoil.* Compost is recommended for increasing soil OM to a maximum of 4% OM. The nutrient and salt content of compost can vary greatly. Only leaf-based composts with low P content should be used on Nantucket. Composts should be tested if the nutrient and salt contents are unknown.

Compost applications should follow the guidelines found in Section 5, "The Role of Compost"; Section 6, "Guidelines for Timing and Rate for Application of Turfgrass Fertilizer"; and Section 9 "Guidelines for Nutrient Management of Gardens, Trees, Shrubs, and Hedges."

4. *Adjust pH* – Adjust the pH of the top 4″ – 6″ of soil to between 6.0 and 7.0 if necessary. Use dolomitic lime to raise the pH if both calcium and magnesium are deficient. Use a calcitic limestone if only calcium is deficient.

5. *Fine grade the site.* This creates the final surface for seeding. Install irrigation systems and make any final pH or OM adjustments prior to final grading if necessary.

6. *Seed.* Certified seed is strongly recommended to guarantee cultivar authenticity. More on selecting turfgrass blends appropriate for use on Nantucket is found later in this section. Apply seed at the rate recommended on the bag. Dry soil should be lightly watered before applying seed. To pregerminate seed for quicker establishment, place it in a cloth bag and soak it in water for at least 12 hours. Lift the bag in and out of the water several times every few hours to aerate the seeds. Remove the seed from the bag and spread it out to dry sufficiently enough to pass through the spreader. If hydro- seeding, be sure to specify the seed mix, seeding rate, and fertilizer content, if included, of the hydro-seed solution. Use a hydroseed mix without added fertilizer if possible.

7. *Apply a starter fertilizer following seed germination*. It is preferable to fertilize after seeds germinate and are capable of using the nutrients. Applying fertilizer prior to germination increases the risk of nutrient runoff and leaching. Fertilizer should be added only if a soil test reveals a deficiency. Any fertilizer application must conform to the guidelines in Section 6: "Guidelines for Timing and Rate for Application of Turfgrass Fertilizer."

8. *Protect the seed*. Lightly rake or roll the area following seeding to maximize seed-to- soil contact and to minimize seed loss to wind or water erosion. Cover the seed with a thin layer of straw or mulch to help protect the seed from temperature extremes and desiccation. Mulching is unnecessary when hydroseeding as most hydroseed mixes include a mulch-like material.

9. *Water.* Keep seeds moist by lightly watering 2–3 times a day, or as necessary, until seedlings are about an inch high. As seedlings grow, reduce watering frequency and increase the amount of water applied to recharge the entire root zone. Allow the surface to dry between waterings. Adjust watering as necessary to account for precipitation, drying winds, and variation in temperatures.

10. *Mow*. A lawn should be mown for the first time when the grass is a third higher than the desired mowing height. For example, if the desired height is 2 inches, mow for the first time when it reaches between 2.5 and 3 inches.

11. *Fertilize.* A follow-up fertilizer application is recommended after the first or second mowing. Apply fertilizer with an application rate of 0.5 lb. N/1000 sq. ft. Apply no more than 3.0 lbs. N/1000 sq. ft. during the year of establishment, Apply P only if a soil test indicates a deficiency. Apply fertilizer in accordance with the guidelines in Section 6.

Establishing a Lawn with Sod: A Step-by-Step Guide
Sod may be the preferred choice to establish a lawn in some circumstances. Examples include establishing a lawn in late fall or when a lawn must be established quickly. Follow these steps when establishing a lawn with sod.

Repeat steps 1 – 5 from above.

6. *Install the sod*. Use quality sod from a reliable source with experience in transporting sod to Nantucket. Lay sod as soon as possible following cutting. Prevent sod from drying out or overheating prior to installation. Select sod grown in soil that is as similar as possible to the soil in which it will be laid. For Nantucket, this usually means selecting sod grown in soils with a low clay content. Sods grown in heavy-clay soils may impede air and water movement into the soil and reduce nutrient uptake. The sod bed should be watered to a depth of 3–4 inches prior to laying the sod to promote rapid establishment. Stagger seams and avoid creating gaps where weeds can become established.

7. *Roll and hand-water*. The sod should be lightly rolled prior to watering to smooth out any surface irregularities. Hand-water sod immediately after rolling.

8. *Water*. Water sod sufficiently to keep the soil moist and promote root establishment. Begin with frequent light watering. As sod matures, reduce watering frequency and increase the amount of water applied to recharge the entire root zone. Adjust watering as necessary to account for precipitation, drying winds, and variation in temperatures.

9. *Fill gaps*. Top-dress any gaps that develop with a mix of topsoil and grass seed that is compatible with the newly installed sod.

10. *Fertilize*. Apply fertilizer with an application rate of 0.5 lb. N/1000 sq. ft. approximately 3–4 weeks after installation. Apply no more than 3.0 lbs. N/1000 sq. ft. during the year of establishment. Apply P only if a soil test indicates a deficiency. Apply fertilizer in accordance with the guidelines in Section 6.

Renovating an Existing Lawn: A Step-by-Step Guide
Renovation is the process of making improvements to, or correcting problems in, an existing lawn. Follow these steps to renovate an existing lawn.

1. *Diagnose and correct underlying problems*. Common problems include poor soil, poor drainage, soil layering, excessive weed content, or inappropriate grasses for Nantucket. Consult an experienced lawncare specialist to help ensure an appropriate diagnosis.

2. *Obtain a soil test*. Obtain a soil test 3–4 weeks before beginning work to allow time to correct any deficiencies in the existing soil. Refer to Section 3: "Soil Nutrient Analysis: The Importance of the Soil Test" for obtaining and applying the soil test analysis.

3. *Prepare restoration area for amendments and seeding*. Mow the restoration area to one inch or lower to allow the new seed to better compete for sunlight and water. Aerate and dethatch as necessary to prepare a good seed bed.

4. *Add soil amendments*. Top-dress and incorporate compost into the soil to a maximum of 4% OM. The nutrient and salt contents of compost can vary greatly. Only leaf-based composts with a low P content should be used on Nantucket. Composts should be tested if the nutrient and salt contents are unknown. See Section 5 for compost application rates. Core-aerate prior to top-dressing with compost to allow it to penetrate below the existing grass layer. Apply N fertilizer in accordance with the guidelines in Section 6. P should be applied only if the soil test indicates a deficiency.

5. *Seed*. Spread the seed at the rate recommended on the bag. Lightly rake and roll the area to ensure good soil-to-seed contact. To pre-germinate seed for quicker establishment, place it in a cloth bag and soak it in water for at least 12 hours. Lift the bag in and out of the water several times every few hours to aerate the seeds. Remove the seed from the bag and spread it out to dry sufficiently enough to pass through the spreader.

6. *Irrigate*. Irrigate in the same manner as for new seedlings to ensure that the seed remains moist at all times while germinating.

7. *Mow*. The lawn should be mown for the first time when the new grass is a third to one-half higher than the desired mowing height.

8. *Fertilize*. Fertilize the restoration area approximately 1–3 weeks after seed germination in accordance with the guidelines in Section 6. The application rate should be no more than 0.5 lb.N/1000 sq. ft. and no more than 3 lbs. N/1000 sq. ft. should be applied during the year of establishment. Apply P only if a soil test indicates a deficiency.

Selection of Turfgrass Species

Turfgrass seed should be selected based on fertilizer needs, local soil and other environmental conditions, the type of use proposed, and the degree of maintenance desired for the turf in question. High-maintenance turf generally requires irrigation, relatively large fertilizer inputs, and increased management time. High-maintenance areas include golf courses, parks, athletic fields, and high-quality or heavily used residential lawns. Low-maintenance areas require little or no fertilization or irrigation and minimal management. They include roadsides, sensitive areas adjacent to wetlands, and lower quality or less frequently used residential lawns.

Turf performance can be improved by combining several species or varieties rather than using a single species or variety. Grass mixes are a combination of two or more different species while a grass blend consists of two or more cultivars of the same species. Blends are often used in highly maintained areas where uniform appearance and performance are required or for over-seeding established lawns. Mixes are often used for lower maintenance lawns. At least three species or three varieties should be included in mixes and blends, respectively, to minimize losses to disease or weather stress. Species mixes and blends for different types of lawns on Nantucket are recommended at the end of this section.

Cultivars of perennial ryegrass, tall fescue, and fine fescues have been developed that contain fungal endophytes. Endophytic fungi live within grasses and do not alter grass appearance. Endophytic grasses have a high tolerance of environmental stress and increased resistance to leaf-feeding insects such as billbugs, sod webworm, and chinch bugs. Some endophytic cultivars of fine fescues also resist dollar spot, a disease associated with low fertility. Fungal endophytes may be toxic to grazing animals, so endophytic grasses should never be planted where animals might graze.

The principal turf grasses used on Nantucket include Kentucky bluegrass, perennial ryegrass, and several species of tall and fine fescues in varying percentages. Characteristics, advantages, and disadvantages of these grass species are summarized as follows:

Kentucky Bluegrass
Kentucky bluegrass has a fine-to-medium leaf texture and is dark green in color. Its growth habit is to spread via rhizomes, making it a popular choice for sod farming. It has the ability to recover fairly easily from damage. Tolerance is high for wear and cold temperature, but moderate for heat and drought. This grass becomes semi-dormant very quickly under hot and dry conditions. It recovers quickly once cooler temperatures with adequate moisture return. Kentucky bluegrass is best grown in well-drained, sunny areas, although a few cultivars will tolerate some shade. It requires higher amounts of nitrogen (2–3 lbs. N/1000 sq. ft. annually) than some other cool-season grasses and may produce a significant amount of thatch if over-fertilized or over-watered. Kentucky bluegrass can be susceptible to diseases such as leaf spot, dollar spot, ring spot, and summer patch. Some newer cultivars show some disease resistance.

Advantages
Fast recovery from wear or abuse
Dense turf
Excellent cold tolerance
Dark green color

Disadvantages
Poor shade tolerance,
Requires regular watering to maintain quality.

Perennial Ryegrass:
Perennial ryegrass has a fine-to-medium leaf texture and tends to be dark green in color. It germinates rapidly and is quick to establish, making it suitable for over-seeding. It is competitive with other grasses and is used either alone or in combinations with Kentucky bluegrass or fine fescues. Use no more than 20% perennial ryegrass when mixing with other grass species. It is wear- and heat-tolerant, but will not tolerate shade well. Perennial ryegrass does best on well-drained soils with moderate fertility. The N requirement for perennial ryegrass is approximately 2–3lb.N/1000 sq.ft. annually. Perennial ryegrass has little thatch accumulation. Perennial ryegrass is susceptible to diseases such as brown patch, Pythium blight, dollar spot, red thread, and rust. Several cultivars contain beneficial fungal endophytes, which provide some disease and

insect resistance.

Advantages
Fast establishment
Good wear tolerance

Disadvantages
Does not tolerate poorly drained soils
Requires full sun.

Fine Fescues.
Fine fescues (creeping red, chewing, and hard fescues) are narrow-leaved, medium-green to dark-green grasses that can be used alone or in combination with other grasses. Each species varies somewhat in terms of growth characteristics, but all are appropriate for low-maintenance situations. They are very tolerant of low pH, low fertility, drought, and shade. Fine fescues become semi-dormant in heat and drought but recover quickly. These grasses require 1–2lbs. N/1000 sq.ft.per year with minimal production of thatch. Fine fescues are susceptible to leaf spot, red thread, and dollar spot. Endophytically enhanced cultivars have some resistance to dollar spot and insects. Cultivars without endophytes are highly susceptible to damage from chinch bugs.

Advantages
Tolerates shade
Requires minimal fertility
Has low water requirements
Disadvantages
Susceptible to heat and drought
Poor wear tolerance and poor recovery rates

Tall Fescues
Many new "turf-type" tall-fescue varieties that are fine textured and dark green are a viable option for lawns. Tall fescue is slow to establish, preferring temperatures above 70° F for optimal germination. It has only a fair recovery potential, but it is both drought and heat tolerant. Tall fescues perform best in well-drained soils in open sunny locations but can withstand moderate shade. Overall, tall fescues are more shade tolerant than Kentucky bluegrass and perennial ryegrass, but less so than fine fescues. Tall fescue requires 2.5–3lbs.N/1000sq.ft.with minimal accumulation of thatch. Most cultivars should not be mown at less than 2″. Tall fescue is susceptible to brown patch, red thread, and pythium blight.

Advantages
Some shade tolerance
Has low water requirements
Good wear tolerance

Disadvantages
Not very cold tolerant.

Recommended Seed Mix for Lower-Maintenance Lawns Requiring Reduced Inputs.
An endophytically enhanced mix of fine fescues is recommended for low-maintenance, non-irrigated lawns on Nantucket. This mix requires little to no nutrient inputs and performs well with minimal care. Fine fescues are deep rooted, use water efficiently, and go dormant only in the driest parts of the season. Fine fescues should be watered only during hot, droughty periods and not more than twice a week; actual timing of watering depends upon turf density, soil type, and temperature. Excessive watering of fine fescues can stress the plant and lead to disease and thin turf. Minimum mowing height for fine fescues is 2.5 inches. Fine fescues may be mixed with a small percentage of perennial rye grass during initial establishment to provide quick cover and erosion control. The fine fescues will replace the ryegrass over time if irrigation is kept to a minimum.

Recommended Seed Blend for a Medium- to High-Maintenance Irrigated Lawn.
A blend of relatively new varieties of turf-type tall fescues is recommended for a dense, dark green, high-quality lawn. Turf-type tall fescues are very similar in color to Kentucky bluegrass, although the leaf is slightly coarser in texture. Turf-type tall fescues develop deep root systems, allowing more efficient use of both water and nutrients. They require only 2–3 lbs. N/1000 sq.ft. per year and should be irrigated only when it becomes visually apparent that it is necessary. Irrigation water should be applied at the rate of one-half inch per application with a maximum of two applications per week. Watering should be monitored to assure recharge into the entire root zone and to avoid over-watering. Good cultural practices are important to maintain tall fescue performance (see Section 10: "Turf Care Cultural Practices"). Annual over-seeding in late summer is recommended to maintain turf density. Turf-type tall fescues look best when they are used alone rather than mixed with Kentucky bluegrass or perennial ryegrass.

Native and Warm-Season Grasses.
Most Nantucket native grasses are varieties of warm-season grasses. While somewhat difficult to establish, once mature, warm-season grasses require little maintenance and no fertilization or irrigation. These species are good choices for open land and property-boundary breaks. More information about the use of native warm season grasses can be found in Section 11: "Alternative Naturalistic Style Practices."

Section 8

Turf Care Cultural Practices

- **Cultural practices for turf maintenance— including mowing, aeration, dethatching, top-dressing, and spiking—all contribute to healthy lawns and in some cases contribute directly to lowering fertilizer requirements.**
- **Mowing height should follow the one-third rule, specifically never mowing off more than 1/3 of the total height of the turf at a time. •**
- **Maintaining sharp mower blades is critical to maintaining healthy, attractive turf.**
- **Recycling grass clippings may contribute up to 33% of nitrogen [N] needs per season, allowing N fertilizer application to be reduced accordingly.**
- **Core aeration, top-dressing, mechanical dethatching, and spiking are turf care cultural practices that contribute to optimum turf health and vitality of more intensively managed lawns, including playing fields and golf courses.**

Mowing

Mowing is the most fundamental cultural practice used to manage turf and plays a large role in its health. Improper mowing can stress and damage turf. The following mowing practices directly influence the vigor and health of turf and in some cases, can reduce fertilizer requirements.

Mowing Height

Mowing height is of primary importance to the health of turf. For aesthetic reasons, some Nantucket lawns are mown at lower than optimum heights. Mowing at a low height can damage turf, particularly for certain grass species, by limiting root growth and production, carbohydrate uptake, and stress tolerance. Mowing higher, particularly during times of extreme heat or drought, is especially important to turf vigor. For example, if mowing is done at a height of two inches instead of three inches in July, water-use efficiency may decrease, fungal pressures may increase, fertilizer requirements may increase, and tolerance to heat and drought may be reduced. Fertility requirements increase with certain species when they are mown too short, due to most of the nutrients being utilized for shoot development instead of other parts of the plant, such as roots. Simply raising the height to three inches may decrease, or eliminate, these stresses.

Sharp Blades/Clean Cuts

Proper blade, reel, or bed-knife sharpening is important for healthy turf. The importance of sharp mowing blades cannot be over emphasized. The tearing or ripping of grass blades, instead of leaving clean, sharp cuts, creates unintended wound surfaces where pathogens can more easily enter and spread disease. The jagged ends also increase water loss. These wounds also give a "brownish" look to the lawn. To maintain clean cuts, mower blades should be sharpened after every eight hours of use.

Mowing Frequency

Removal of more than one third of top growth at any given time can directly slow or stop root growth. Because the degree of root growth is crucial to the success of a healthy turf, whenever possible mowing frequency should be based on how fast or slowly the grass is growing, adhering to the "one-third rule" – remove a maximum of one-third of the grass height while mowing.

Recycling Clippings
Recycling clippings over the course of the growing season can add up to 33 % (1.0 lb. N/1000 sq. ft.) of the annual nitrogen [N] requirement. Mulching mowers, designed to chop mown grass into fine pieces, not only recycle N but also increase mowing efficiency as bags don't need to be emptied or clippings hauled away. Because lawn clippings from either a mulching mower or a reel mower are composed of easily degradable compounds, they break down rapidly and do not contribute to thatch buildup.

Core Aeration
Core aerating the soil is especially beneficial for compacted turf surfaces such as heavy-use lawns and playing fields and irrigated lawns. It not only alleviates surface compaction but increases microbial activity, water infiltration and gas exchange. Aeration also helps reduce excess thatch. Thatch is necessary in small amounts to cushion the crown of the plant and provide some water- and nutrient-holding capacity. However, excess thatch leads to increased water requirements, decreased fertilizer efficiency, decreased root vigor, increased insect pressure, and greater disease susceptibility. It is recommended that high-use lawns or playing fields be aerated a minimum of once a season. Fall is the preferred time for aeration as lower temperatures aid in recovery.

Dethatching
Dethatching is a practice that uses vertical blades to slice through the turf canopy and, depending on the depth setting, into the thatch. It also helps to clean the surface and mat area (zone between crown and thatch) of any accumulated debris. Dethatching contributes to reduced water use, increases the efficiency of fertilizer uptake, and decreases the incidences and severity of turf diseases.

Top-dressing
Top-dressing is the application of a layer of material, such as sand or compost, across the turf surface or into the root zone after core aeration. The sand or compost is then brushed into the turf canopy and eventually finds its way into the thatch layer. Top-dressing can help dilute thatch, provide protection for the crown of the plant, and smooth out low areas. Top-dressing can increase N utilization and water infiltration while decreasing water use. Top-dressing with compost also adds beneficial microbes and bacteria to increase microbial activity while building the soil. Compost contains N and P, so it is important to know the compost nutrient content before making applications. Top-dressing associated with and immediately after core aeration is recommended as there is less chance that compost will form "bands" of P or N.

Spiking
Spiking is the cutting of spikes 1–3 inches deep into the subsurface. It is a cultural practice commonly used on high-use and high-maintenance turfs such as playing fields and golf courses. Although these practices do not relieve compaction or control thatch, they do allow oxygen to enter the root zone, improve water infiltration, and provide a good environment for over-seeding and repairs.

Section 9

Nutrient Management of Gardens, Trees, Shrubs, and Hedges

- **Fertility guidelines for ornamental plantings are aimed at maintaining acceptable soil fertility while reducing the risk of nutrient contamination of Nantucket's aquatic resources.**
- **Due to its nutrient content, compost is considered a fertilizer for the purposes of the *BMP*.**
- **No phosphorus [P] should be added to soil unless a soil test identifies a deficiency. Certain exceptions are made for compost.**
- **Animal manure composts contain high amounts of P and should not be used unless a soil test indicates a significant P deficiency.**
- **Leaf-based composts are low in P and are recommended for use on Nantucket.**
- **The maximum recommended soil organic matter [OM] content for Nantucket's sandy soils is 4%.**
- **When using compost to increase soil OM, multiple small applications should be applied at 8–12 week intervals rather than one large application.**
- **No more than 2 lbs. nitrogen [N] per 1000 sq. ft. should be applied annually to ornamental plantings; individual applications should not exceed 0.5 lb. N/1000 sq ft.**
- **Fertilizers, including compost, should only be applied on Nantucket after April 15 and before October 15 and when soil temperatures are above 55^{o}F.**
- **Any granular fertilizers applied to ornamental plantings should be mixed into the top one or two inches of soil to minimize the potential for loss from surface runoff.**
- **Most trees, shrubs, and hedges adjacent to lawns will not require supplemental fertilizers once established unless a lack of vitality is observed and a deficiency is identified by a soil test.**
- **Native plants are well adapted to local conditions and do not require fertilization.**

Herbaceous perennial gardens, mixed borders, vegetable gardens, and ornamental trees and shrubs (henceforth referred to as "ornamental plantings") are common components of Nantucket's residential landscapes. There is substantial variation in the nutrient requirements and appropriate cultural practices among the many species and varieties of ornamental plants found on Nantucket. A detailed description of the best management practices for each species is beyond the scope of this *BMP*. Instead, this section will present guidelines for fertilizing and building the soil with compost for ornamental plantings.

Important basic information that applies to ornamental plantings is provided in Section 3: "Soil Nutrient Analysis: The Role of the Soil Test"; Section 4: "Fertilizer Types and Sources"; and Section 6: "Guidelines for Timing and Rate for Application of Turfgrass Fertilizer." Since many, if not most, of the ornamental planting beds on Nantucket are amended with compost, landscape practitioners should pay particular attention to Section 5: "The Role of Compost" for recommendations and limitations on compost application for ornamental plantings.

Nutrient Application to Ornamental Plantings

Most of the material relating to turf soil fertility discussed in other section of the *BMP* also applies to ornamental plantings, though there are differences. Perhaps most important, the diffuse root structure of most ornamental plants is not as efficient in nutrient uptake as the dense rooting system of turf, which causes ornamental beds to be much more prone to nutrient leaching than turf. Although ornamental plantings may make up a relatively small portion of a residential landscape, their nutrient "leakiness" can make them relatively large contributors to nutrient contamination of groundwater and wetlands. The recommendations for nutrient application

provided in this section are aimed at achieving healthy ornamental plantings while reducing negative impacts to water resources.

The nutrient content of commercially available fertilizers is discussed in detail in Section 4. The nitrogen [N] and phosphorus [P] content of various types of compost are presented in Tables 3 and 4 in Section 5. The *BMP* allows a maximum of 2 lbs. N/1000 sq. ft. per year to be applied to ornamental plantings, and P may be applied only if recommended by a soil test. A comprehensive soil test, as outlined in Section 3, should be conducted prior to establishing ornamental plantings and at least every three years thereafter. Soil should be tested annually in areas being amended with compost or if fertilized with P. Only those nutrients recommended by the soil test should be applied. In some cases, fertilizer blends that are specifically formulated for ornamental plantings or specific ornamental species may not be appropriate for use on Nantucket as they may contain nutrients not recommended by a soil test.

Climate plays an important role in the timing of fertilizer applications for ornamental plantings. Fertilizers, whether in composts or in granular or liquid form, should be applied only between April 15 and October 15 and when soil temperatures are above 55^{o}F (see Section 6). Granular fertilizers applied to ornamental plantings should be mixed into the top one or two inches of soil to reduce the likelihood of fertilizer runoff from bare soil. Fertility requirements for hedges, trees, and shrubs planted within or adjacent to lawn areas will most likely be met by fertilizers applied to turf. No additional fertilization is recommended unless visual observation or a soil test identifies a deficiency. Native plants incorporated into ornamental landscapes are well adapted to local conditions and should not be fertilized (see Section 11: "Alternative Naturalistic Style Practices").

Compost as Soil Conditioner and for Soil Fertility

Compost is often applied to ornamental beds in order to increase soil OM and nutrient content. Compost is commercially available in bags or bulk for the landscape trade. Soil OM improves soil structure, aeration, water- and nutrient-holding capacity, biological activity, and fertility. Most of the nutrients in soil OM are slowly released as the OM decomposes. Phosphorus is an exception, and up to 85% of the P in manure-based compost can be in fast-release form. The OM decomposition rate depends on a variety of factors including soil moisture, aeration, temperature, and biological activity and the type of compost used. The OM decomposition rate tends to be high in sandy soils, so care must be taken to avoid over-application on Nantucket's sandy soils. All composts used as soil amendments on Nantucket must have a known nutrient content or be tested for nutrient content before use.

Although a soil OM content of between 5% and 8 % with soils amended to a depth of 8–12 inches is often recommended for ornamental plantings, these values are not appropriate for Nantucket. Nantucket's native sandy soils tend to have much lower OM content, ranging from 0.8 to 3.5 %, with a topsoil depth of only a few inches. It is difficult to increase soil OM content more than about 1% above the native OM content without increasing the likelihood of nutrient leaching. Therefore, the BMP recommends a maximum soil OM level of 4% for Nantucket soils used for ornamental plantings. Both the percent OM and depth of OM amendment should be increased slowly over several years, and such efforts should include monitoring of soil test P levels to ensure the Environmental Critical Level [ECL] for P is not exceeded. Adding additional

OM increases the risk of excessive nutrient application and nutrient loss to leaching or runoff. This process of using soil-test P values to limit additions of compost to soils and hence the soil OM content is discussed in more detail in Section 5. Care must be taken when amending native soils with commercially available "topsoil" or "organic topsoil." These products often contain a high percentage of organic matter and can easily overload the soil with nutrients and result in nutrient leaching.

Compost Application Based on Phosphorus Content

Compost contains varying amounts of N, P, and other nutrients, depending on its source (see Table 1 in Section 5). Although the nutrient concentration of most composts is lower than that found in most granular fertilizers, compared to granular fertilizers, much larger amounts of compost are often applied to soils, so care must be taken to avoid over- applying compost. Leaf-litter compost tends to be the lowest in N and P and is the preferred compost for use on Nantucket. Manure- and lawn-, garden- and food-waste composts contain much higher levels of N and P, and some manure-based compost, especially poultry-manure compost, contain excessive amounts of soluble salt. Manure- based composts should not be used on Nantucket unless a soil test indicates a severe nutrient deficiency.

All currently available composts contain P in amounts that may result in over-application if applied at commonly recommended rates (see Table 3 in Section 5). Soil-testing laboratories typically use either the Modified-Morgan or the Mehlich III extraction method to determine soil P levels. These tests use different extraction solutions and produce very different results. The soil-test report will indicate which extraction method was used. It is important for applicators to use the same soil-testing laboratory and extraction method for repeated soil testing on a given property so that values can be compared.

This *BMP* recommends compost application rates based on soil and compost P content and on the Agronomic Critical Level [ACL] and Environmental Critical Level [ECL] of P in an effort to ensure that soil P levels do not exceed recommended amounts. The ACL is the soil P level at which an adequate amount of P is present for crop or turf production. The recommended P application rate in the soil-test report is designed to bring the soil P concentration to, or slightly above, the ACL. The ECL is the soil P level at which P will run off or leach from the soil in amounts that can cause environmental damage. In general, the ECL is higher than the ACL, but the difference may be small, especially in sandy soils (Table 6). For example, there is only a small difference between the ACL and the ECL for the Modified Morgan extraction for ornamentals (Table 6). This results in a very small margin of error when applying P in sandy soils especially for soil tests conducted with the Modified Morgan extraction method.

Table 6. *The Agronomic and Environmental Critical Levels for many ornamental plants for the Modified Morgan and Mehlich III extraction methods.*

Extraction Method	Agronomic Critical Level	Environmental Critical Level
Modified Morgan	10 PPM or 20 lbs./acre	14 PPM or 28 lbs./acre
Mehlich III	50 PPM or 100 lbs./acre	150 PPM or 300 lbs./acre

PPM = parts per million.

Compost application procedures for ornamental plantings should follow the detailed guidelines presented in Section 5.

Compost Nitrogen Content

Although the BMP guidelines for compost application are based on soil and compost P content, attention must also be paid to the amount of N applied in compost. Table 4 in Section 5 provides estimates of total lbs. of N per 1000 sq. ft. contained in various types of compost. Nitrogen in compost is slowly released as the compost decomposes. Approximately 10-to-25% of the N is mineralized and released during a one-year period, although the release rate is more likely near the 25% rate on sandy soils. Therefore, a compost application containing 8 lbs. N/1000 sq. ft. would be expected to release about 2 lbs. N/1000 sq. ft. during the first year, which is the maximum allowed by the *BMP*. However, adding that much of any compost would supply about 8 lbs P_2O_5/1000 sq. ft. and would most likely overload the soil with P. Therefore, it may not always be possible to achieve the desired annual N release rate using only compost, and organic landscape practitioners may need to supplement compost with organic fertilizers that contain no P.

Since only a portion of the compost decomposes each year, much of it remains in the soil and is released over several years. Repeated compost applications may overload the soil with N and increase the possibility of nitrate loss to leaching or runoff. If compost application rates are based on N availability, then only the amount of compost required to replace the amount that has decomposed should be added. Soil OM content can be determined by conducting a soil test.

The Nantucket *BMP* recommended application rates for compost, together with estimates of P and N content and availability, were determined after extensive discussion and communication with science reviewers listed in the Acknowledgments. The ECL for Nantucket's soils was arrived at from recent research on sand soils and after consultation with several of the turf science professionals who reviewed the *BMP* (see Bibliography).

Section 10

The Role of Irrigation

- **Placement of the irrigation system should be included in the initial site-planning process and included in the final as-built plan.**
- **Irrigation zones should be tailored to the requirements of specific plantings including turf, gardens, or mixed borders.**
- **Irrigation water should not penetrate below the root zone. A simple soil probe or spade can be used to determine depth of moisture from irrigation.**
- **Regular monitoring and adjustment of irrigation-control clocks over the course of the growing season are important to provide adequate moisture for plants without overwatering.**
- **Excess irrigation may contribute to runoff or leaching of fertilizers.**
- **Special monitoring of irrigation at times of planting, fertilization, and renovation is essential for promoting healthy plant growth and avoiding runoff or leaching.**
- **Turn irrigation systems off during periods of adequate rainfall.**
- **Avoid watering impervious surfaces such as sidewalks, driveways, and roads.**
- **Seasonal record-keeping of natural precipitation and clock adjustments is recommended.**

Properly designed, monitored, and maintained irrigation systems play an important role in managed landscapes and gardens on Nantucket. Proper water management promotes healthy landscapes while reducing the leaching of fertilizers into our groundwater, ponds, and harbors.

System Design

The design of an irrigation system for a new landscape should be based on careful site planning as outlined in Section 2: “Site Assessment and Planning." Permission from the Nantucket Conservation Commission must be obtained before installing irrigation systems within 100 feet of wetland resource areas. The location and separation of the system into different zones should be tailored to specific site conditions as well as the water requirements of the different aspects of a proposed landscape. For example, a lawn, or the part of it on a windy exposed site, will require more water than a lawn in an area more protected area. Turf has different water requirements than a shrub border, or a perennial garden. Some shrubs popularly used in Nantucket gardens, hydrangeas for example, need more water than others that are more adapted to Nantucket’s conditions. After becoming established, a border of native plants may need no irrigation at all.

Both the professional landscaper and the homeowner will find an as-built map or diagram showing labeled irrigation zones of a particular landscape and garden a useful tool for effectively understanding and monitoring the system. Keeping irrigation-clock labels properly updated over time and as changes are made to systems is also important.

System Monitoring

Regular monitoring of the irrigation system over the growing season is fundamental to using water efficiently and avoiding over-watering, which may increase the possibility of fertilizer leaching or surface runoff. Coordination of watering with fertilizer applications is especially important. When turf fertilizer has just been applied, providing the correct amount of water to replenish just the root zone is crucial in avoiding leaching to ground- water. Depth of root zone and water from irrigation or rainfall can be easily determined with a simple soil probe or shovel.

New landscapes initially require more water as turf and plants are becoming established. Close observation of watering needs over time will usually lead to less water being used as plants and turf mature, except during times of extreme heat and drought.

A recommended component of monitoring irrigation is to keep a written journal of clock adjustments and weather conditions over the growing season. Adjusting the irrigation system during the growing season so that irrigation supplements natural rainfall patterns is recommended practice.

The simplest way to avoid excess watering, which may contribute to fertilizer runoff or leaching, is to turn irrigation clocks off when it is raining. Wait to turn clocks back on until conditions warrant.

System Maintenance

Over time, as plantings grow and mature, water coverage throughout an irrigated landscape should be inspected and reviewed. Sprinkler-head locations may periodically need to be adjusted to ensure adequate moisture is reaching the plants they were intended for. Careful annual inspection of water coverage when systems are reactivated in the spring should include any necessary revisions to ensure efficient watering.

In summary, irrigation systems are useful components of successfully managed landscapes and gardens. Seasonal and long-term monitoring and clock adjustment in conjunction with plant growth needs and weather conditions are important aspects of a successful irrigation system.

Irrigation-system design based on specific site conditions, regular maintenance, and adjustment over time—especially close monitoring and record keeping during the growing season—will help direct fertilizers to the plants they are intended for while promoting healthy landscapes with minimal risk to nutrient runoff or leaching to our ponds, harbors, and groundwater.

Section 11

Alternative Naturalistic-Style Practices

- **Native plants occur naturally in an area and were not introduced by people.**
- **Naturalized plants were introduced by people and have adapted to natural conditions.**
- **Native and naturalized plants are: well adapted to local conditions; do not require fertilizer; are often resistant to diseases and pests; and support local biodiversity.**
- **Preserving existing areas of native plant communities is encouraged in the site-planning process.**
- **Native plants are recommended for use in managed landscapes as ornamental plants, borders, or buffers.**
- **Restoration of disturbed lands with native grasses is recommended.**
- **Invasive exotic plants are introduced species that aggressively displace native species. Removal of invasive exotic species is recommended where possible.**

The naturalistic style of landscape design and management is based on knowledge of existing plant communities, the conditions in which they grow, and an understanding of how plant communities develop and change over time. It is an approach based on knowledge of, and adaptation to, self-sustaining landscapes that exist on Nantucket.

Naturalistic-style landscapes require little or no alteration of existing conditions, no irrigation, and no fertilizer inputs. Entire individual properties can be designed and managed in a naturalistic style, or, some naturalistic-style practices can be incorporated as components of higher-maintenance landscapes. Thorough site assessment and planning determines how much of a particular property is desired or needed for fertilizer-dependent turf or plantings and how much can be managed naturalistically, whether restored or left undisturbed.

The principles and practices of naturalistic landscaping are closely related to the science of ecological restoration but on a smaller scale. For further information on ecological restoration and alternatives to lawns, refer to the Bibliography for a list of recommended reading.

Native Plants
There are many benefits to using native plants in man-made landscapes. Native plants are those that have evolved naturally in an area, in our case Nantucket with its unique setting, history, and conditions. Specifically, native plants refer to plants that were growing here before humans introduced plants from distant places. Native plants consist of plant species and communities adapted to similar soil, moisture, and climate conditions. The native plants we have on Nantucket today are also influenced by the impact of historical land uses including grazing and farming practices, as well as the relatively recent introduction and spread of invasive plant species.

One of the primary benefits of using native plants is that, once established, they require no fertilization or irrigation. Other benefits are winter hardiness, drought tolerance, and for most species, increased pest and disease resistance.

Naturalized Plant Communities
Over time, plants introduced from around the world have adapted to Nantucket's conditions, and

become naturalized. Some of them are common in natural areas and many would mistake them as natives. Examples of naturalized plants are Rosa rugosa, found in stands on sand dunes; almost all of the pines growing on the island; and common roadside weeds or wildflowers, such as Queen Anne's lace and common daisies.

Some introduced plants have great competitive advantage over native plants and are considered exotic invasives. A few examples of exotic invasives on Nantucket are Japanese knotweed [*Polyganum cuspidatum*], which has a bamboo-like appearance and spreads rapidly forming dense monocultures; Japanese honeysuckle [*Lonicera japonica*], one of the first shrubs to leaf out in the spring and gaining a dominant foothold in more and more areas of the island; and oriental bitter sweet [*Celastrus orientalis*], a very aggressive vine with orange and yellow berries that is unfortunately used for decorating, inadvertently promoting its spread. Exotic invasives tend to be found predominantly on disturbed lands and old dumping grounds. They are continuing to spread and are altering native plant communities. When preserving naturalized plant communities as part of the landscape, one should remove exotic invasives, where possible, and encourage native plant communities.

As with all plant communities, naturally occurring vegetation continues to change over time. An understanding of what factors influence past, present, and future changes is fundamental to implementing management decisions for natural areas if incorporated as part of the man-made landscape. Preserving an area of undisturbed plant communities or planting with native plant species are two distinct naturalistic style practices.

When a nursery-grown native plant is planted in an amended garden soil, it will perform differently from the same native species existing in Nantucket's natural soil conditions. One of the keys to successful use of native plants is to replicate the natural conditions the native plant grows in. The second is to carefully monitor the transition from nursery-grown plant to established landscape plant. The seasonal timing of planting and the size of the plant are contributing factors to the successful use of native plants. The ease or difficulty of establishment varies species to species. The third factor in the successful use of native plants, once established or preserved, is to manage them appropriately, which means hardly at all.

As mentioned in Section 2. "Site Assessment and Planning," it is common for new construction practices in rural parts of the island to disturb more area than will be necessary for a well-planned man-made landscape. Those extra areas, between the designed functional landscape and undisturbed land beyond, are opportunities to
incorporate alternative naturalistic landscape practices. The primary benefit, as it relates to the *BMP*, is the overall reduction of fertilizer use by incorporating alternative plantings that require no fertilizers. A corollary benefit is the aesthetic softening of edges between the closer, "tamed" landscape, and the surrounding "wild" natural areas beyond.

Tall Grass Meadows

One recommended practice for restoring disturbed land is to plant areas with native grass species. Sand-plain grasslands, one of Nantucket's special native plant communities, is an excellent model for a grassland. Little bluestem [Schizachyrium scoparius], switchgrass [Panicum virgatum], and Pennsylvania sedge [Carex pennsylvanica] are three native-grass

species that work well for meadow planting. When a grassland is being established, it is important to use existing Nantucket soil, not to fertilize, and to water only during extreme drought periods. Amended soil, fertilizer, or added irrigation will increase the competitive advantage of weeds compared to native species. In time, with selective hand-removal of unwanted species and mowing once or twice a year (at a recommended height of 3–4 inches), a grassland will mature and even incorporate other native species that grow from seed found in native soil and surrounding vegetation. The land above and around a newly installed or repaired septic system leach area is a recommended location for establishing a grassland.

Using Native Trees and Shrubs

The inclusion of native plant shrub buffers, whether of newly planted or of preserved existing vegetation, is another example of naturalistic style practice, that when used reduces fertilizer inputs. If a preserved shrub thicket is included as an edge planting or integrated part of a man-made landscape, it requires no fertilizer or water. Below are some native shrubs and trees recommended for buffer plantings, available in local nurseries. Cultivars and varieties of many native species have been selected or developed for landscape use.

Shrubs

Bayberry – *Myrica pennsylvanica*
Viburnum – *Viburnum dentatum*
Beach plum – *Prunus maritima*
Inkberry – *Ilex glabra*
Winterberry – *Ilex verticillata*
Sweet pepperbush – *Clethra alnifolia*
Highbush blueberry – *Vaccinium corymbosum*

Trees

American holly – *Ilex opaca*
Red maple – *Acer rubrum*
Sassafras – *Sassafras albidum*
Tupelo – *Nyssa sylvatica*
American beech – *Fagus grandifolia*
White oak – *Quercus alba*
Black oak – *Quercus velutina*

Native plants and plant communities, when planted and established correctly, do not require fertilizers or irrigation, and thus contribute to reducing potential nutrient leaching into our aquatic resources.

Appendix 1. Recommended Soil and Compost Testing Laboratories

- A & L Analytical Laboratories, Inc., 2790 Whitten Road, Memphis, TN 38133 Phone 800 -264-4522; 901-213-2400 Fax 901-213-2440 http://www.al-labs.com/

- UMass Soil Testing Soil and Plant Tissue Testing Laboratory, West Experiment Station 682 North Pleasant St., University of Massachusetts Amherst, MA 01003 http://www.umass.edu/soiltest

- The University of Maine: Analytical Laboratory and Maine Soil Testing Service, 5722 Deering Hall, Orono, ME 04469-5722 http://anlab.umesci.maine.edu/

Appendix 2. Sources and Types of Nitrogen, Phosphorus, and Potassium

2.A. Sources and Types of Nitrogen Fertilizer

2.A.1 Sources and Types of Fast-Release Nitrogen Fertilizer

2.A.1.a Synthetic Fast Release Nitrogen Fertilizers. Fast release synthetic nitrogen (N) fertilizers are generally applied in products that contain a variety of other nutrients.

Urea. Urea is the most widely used of all N fertilizers. Urea is a simple organic molecule that occurs naturally in animal urine though most urea used in fertilizers is manufactured. Urea is soluble in water and is rapidly broken down in the soil to release ammonia making if a fast release N source. Urea can be coated or chemically altered to make it slow release (SRN) and it is the main constituent of synthetic SRN products.

Ammonium sulfate. Ammonium sulfate is a fast release fertilizer with NH_4^+ as the N source. Ammonium sulfate releases N at cooler soil temperatures than urea and most other N sources.

Potassium nitrate – Potassium nitrate is a fast-release fertilizer with NO_3^- as the N source and is also a source of potassium (K).

Ammonium nitrate. Ammonium nitrate is a fertilizer with both NH_4^+ and NO_3^- as N sources. Ammonium nitrate is typically found as a constituent of blended fertilizers or synthetic slow-release nitrogen fertilizers (SRN). Straight ammonium nitrate is very difficult to purchase and used mainly in agricultural applications.

2.A.1.b Organic Fast Release Nitrogen Fertilizers. Most fast release organic fertilizers contain a variety of other plant nutrients. Though these sources are listed as fast release nitrogen, some of their total N content may be in slow release form.

Compost tea – Compost tea is a water extraction of compost that contains fast release N and is generally applied in small amounts as foliar fertilizer.

Blood meal – Blood meal is derived from animal blood that is heated, dried, and ground. Blood meal contains a high percentage of N and has the potential to burn plants if over applied. Blood meal also contains phosphorus (P), K and iron (Fe).

Meat meal – Meat meal is derived animal tissue and also contains P and Fe.

Fish meal – Fish meal is derived from fish tissue and also contains P and K.

Seaweed (Kelp Powder and Liquid Kelp) – Kelp powder and liquid kelp contain small amounts of N, P, and K and high amounts of micronutrients. Liquid kelp is typically used as a foliar fertilizer.

All fast release fertilizers, whether synthetic or organic, are susceptible to leaching if improperly used or used in excess of the rate guidelines in Section 6.

2.A.2 Sources and Types of Moderate to Slow-Release Nitrogen Fertilizers

Group I. Carbon-containing compounds are dependent on microbial decomposition for nitrogen release. Maximum nutrient release occurs when soil temperatures are above 55°F, pH is 6.5, and there is adequate moisture present. This group includes natural organics and ureaformaldehydes (UF). UFs are synthetically produced organic compounds that function in a similar manner to naturally occurring organic fertilizers.

Natural Organics – The nitrogen in natural organic fertilizers is derived from animal and plant materials. Sewage based products are also considered to be natural organic fertilizers though their use on Nantucket is discouraged because of heavy metal content.

- Moderate to slow release organic N sources
    - Fish emulsion – Fish emulsions are soluble, liquid N fertilizers derived from fish waste processed by heat and acid. They also contain micronutrients.
    - Fish hydrolyzate – Fish hydrolyzate is derived from fish waste that is partially digested by enzymes. Fish hydrolyzed also contains P, K, micronutrients, vitamins, and proteins.
    - Alfalfa meal – Alfalfa meal is also contains P, K, and bio-stimulants. Alfalfa meal is also used to increase soil organic matter content.
    - Crab meal – Crab meal also contains P, K, and calcium.
- Slow to very-slow release organic N sources
    - Feather meal – Feather meal is derived from poultry waste and has a higher N content than most organic fertilizers.
    - Seaweed (Kelp Meal) – Kelp meal is derived from seaweed and is low in N, P, and K but high in micronutrients.
    - Cottonseed meal – Cottonseed meal also contains P and K, with a typical analysis of 6-2-2.

Ureaformaldehyde (UF) fertilizers – UF fertilizers are synthetically produced fertilizers that may contain "fractions" that vary in N release rate from several weeks to several years.

Below are two examples of UF fertilizers containing different 'fractions'. Please note that they are referenced by their brand name because that is how they are often identified by practitioners. This use of names is not an endorsement of any particular product.

- Nutralene – Nutralene is a mix of water soluble fast release nitrogen (WSN), slow release nitrogen (SRN), and methylene urea. Nutralene depends on temperature, microbial activity, and soil moisture to release the SRN over a 16-week period.

- Nitroform – Nitroform is similar to Nutralene and contains WSN, SRN, and WIN, but with a greater percentage of WIN than Nutralene. Nitroform releases N over a 22-week period.

Group II. These products contain carbon compounds that have a low solubility in water. Nitrogen is released as the fertilizer particles are slowly dissolved by water. Group II fertilizers can release N at cooler soil temperatures than Group I fertilizers.

Below is one example of a Group II fertilizer.

IBDU – Isobutylidene diurea – IBDU releases N through a process called slow hydrolysis. IBDU is the slow-release component in many combination products and the percentages of slow release can vary from 25% to 90% of total N.

Group III – These products consist of water soluble N compounds that are coated with a physical barrier such as polymers, plastic, and sulfur that delay N release.

An example of each is presented below:

Polymer Coated Urea – Polyon is an example of Polymer Coated Urea. Nitrogen slowly diffuses through Polyon's membrane coating at a rate that varies with soil temperature. Release is not dependent on moisture or microbial activity. Polyon is available in a number of formulations that contain different amounts of fast release N along with the SRN.

Plastic Coated Urea - Osmocote is sealed with a plastic/polymer coating. The release of nitrogen is largely dependent on temperature and to a lesser degree on water. The release rate of nitrogen is mainly determined by the thickness of the plastic - the thicker the coating, the longer the release time.

Sulfur Coated Ureas (SCU) – SCUs have coatings that are slowly dissolved by water. The best SCUs have thick, consistent coatings that accurately control the rate of N release. Some inexpensive SCU have weak coatings that are easily broken by handling or by mower traffic. Broken coatings allow for a more rapid release of N. Some SCUs seal and protect the coating with wax which helps slow the release of N. The wax sealant is

slowly removed by microbial activity. Only high quality SCU products with thick consistent coatings should be used.

2.B. Sources and Types of Phosphorus Fertilizer

Since most organic fertilizers contain P in addition to N, many sources of P are detailed in the prior category with N. Additional sources of organic and synthetic P are detailed below:

- Additional organic sources of phosphorus

  - Bone meal – Bone meal is derived from the bones of poultry, cows, or pigs that have been sterilized with intense heat. The amount of N in bone meal is low and it is used more often as a source of P. If used as a N source, it is imperative to take into account the amount of phosphorus in bone meal. When using bone meal, the amount of P should be applied based on a soil test identified deficiency and recommendation.

  - Mushroom compost – Mushroom compost is the composted waste from commercial mushroom growing facilities and is typically derived from horse manure. Mushroom compost has a very high P content and a small amount of slowly released N.

  - Bat guano – Bat guano is a good source of P and also contains N and K. Its N release rate is fast to medium so consideration of N rates and timing must be accounted for. Bat guano is preferably included as part of a slower release blend.

  - Worm castings – Worm castings also contain small amounts of N and K and are a good source of organic matter.

  - Soft rock phosphates – Though not truly organic, soft rock phosphates are derived from naturally occurring clay deposits that include phosphate and calcium. Soft rock phosphates can require 3-12 years to completely breakdown.

- Synthetic sources of phosphorus

  - Monoammonium phosphate (MAP) – MAP is a fast release source of P that also contains fast release N. MAP's typical analysis is 11-52-0.

  - Diammonium phosphate (DAP) – DAP is a fast release source of P which also contains fast release N. DAP's typical analysis is 18-56-0.

  - Monopotassium phosphate (MKP) – MKP is a fast release source of P and K but contains no N. It is often used for foliar applications. MKP's typical analysis is 0-52-34.

  - Triple super phosphate – Triple super phosphate is a fast release synthetic source of P that is popular in greenhouse and garden uses.

2. C. Sources and Types of Potassium Fertilizer

- Greensand. Greensand is a naturally derived source of K extracted from mineral deposits that were once part of the **o**cean floor. Greensand may contain small amounts of P.

- Sulfate of potash. Sulfate of potash is a naturally occurring mineral. It also contains sulfur and has a low burn potential.

- Langbeinite. Langbeinite is a naturally occurring mineral extracted from evaporated seawater. It also contains sulfur and magnesium. Langbeinite is often referred to as Sul-Po-Mag.

- Muriate of potash. Muriate of potash is a synthetic source of K that is popular in fertilizer blends due to its low cost of manufacturing. However, muriate of potash contains chlorine, which may negatively impact soil microbial populations. It also has a high burn potential on turfgrass. The use of muriate of potash is not recommended on Nantucket.

Appendix 3. Sample Record Keeping Sheet for Fertilizer Applications

NAME OF APPLICATOR:_____
LICENSE #_____
CUSTOMER:_____
LOCATION:_____
APPLICATION DATE:_____
PRODUCT:_____
PRODUCT:_____
PRODUCT:_____
ADDITIONAL INGREDIENTS:_____
WEATHER CONDITIONS:_____
AREA OF APPLICATION IN SQUARE FEET:_____
APPLICATION RATE IN #s/1000 SQ. FT.:_____
SPREADER SETTING:_____
AMOUNT OF PRODUCT USED:_____
TYPE OF PLANTING:_____
SITE OBSERVATIONS:_____
TOTAL N, P, AND K APPLIED DURING SEASON:_____

Appendix 4. Instructions for Spreader Calibration: A Step by Step Guide:

Step 1. Calculate the pounds of product to be spread. Pounds of a given nutrient per 1000 sq. ft. is the most common way to describe the application rate of fertilizer products for turfgrass. Pounds per acre (lbs/A) is sometimes used, especially for large applications of lime and compost.

In this example we will apply a fertilizer with a 10-0-8 analysis (10% nitrogen) and with an application rate of 0.5 lb nitrogen (N) per 1000 sq ft. The required amount of product to apply per 1000 sq ft must first be calculated. We calculate the pounds of product per 1000 sq ft as follows:

Convert the percent of N in the product to a decimal portion by dividing by 100%.

In this example: 10% / 100% = 0.1

Product application rate = N application rate divided by the decimal portion of N in product

In this example: 5# product/1000 ft sq = 0.5# N/1000 ft sq / by 0.1 N in product.

Step 2. Weighing the required material for calibration. We next calibrate the spreader to apply 5# product /1000 sq. ft. First, weigh and load a known amount of fertilizer into the spreader. A basic rule is to load twice the amount of the desired rate of product; in this case that would be 10 pounds of fertilizer.

Step 3. Determining spreader swath width of fertilizer for calibration. The swath width is determined by walking at normal speed, engaging the spreader, and measuring the width of the fertilizer thrown from left to right. Because the amount of fertilizer decreases at the edges of the swath, it is a good practice to overlap swaths slightly (6-12 inches). Let's assume that our swath width was 10 feet.

Step 4. Setting up calibration course. We now know our swath width (10 feet) and pounds of product needed per 1000 sq. ft. (5) necessary to achieve our desired rate of 0.5 lb of N per 1000 sq. ft. We now set up a 1000 sq ft area for calibration. Dividing 1,000 by the 10-foot swath width, we get 100 feet; this is our "run." Measure out 100 feet being sure to mark the starting and ending points. Set the spreader using the setting on the bag as a starting point only. A fertilizer label might have a 'recommended' setting for your desired rate and type of spreader. This setting can be a starting point for calibration.

Step 5. Walking the calibration course and completion. Begin fertilizing while walking at a normal pace until reaching the end point. After finishing this calibration course, empty the remaining fertilizer into the bucket and weigh the material using a scale. If you still have 5 pounds remaining, your calibration is correct. If you have too much or not enough left, adjust the spreader setting, and repeat the calibration using a different calibration course. This is a very important point – using the same course can effectively double the amount of fertilizer applied in

that area. This is not only harmful to the turfgrass, but allows for the possibility of leaching and/or runoff. Once proper calibration has been achieved, do not fertilize the calibration course or courses for the same reason as above. Of course, you can calibrate on a hard surface that allows for recovery and proper clean up of the fertilizer.

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Appendix B
Massachusetts Prohibited Plants List

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS

Department of Agricultural Resources
251 Causeway Street, Suite 500, Boston, MA 02114
617-626-1700 fax: 617-626-1850 www.mass.gov/agr

MDAR
MASSACHUSETTS DEPARTMENT OF AGRICULTURAL RESOURCES

Massachusetts Prohibited Plant List

Following is a list of plants for which importation and propagation is currently prohibited within the state of Massachusetts.

The original list of prohibited plants went into effect January 1, 2006. Certain species were subject to a phase-out period that expired on January 1, 2009. As of this date, the sale, trade, purchase, distribution and related activities for the species below, including all cultivars, varieties and hybrids, are not allowed:

Common Name	Scientific Name
aeginetia	*Aeginetia spp.*
African boxthorn	*Lycium ferrocissimum*
African couch grass	*Digitaria abyssinica; D. scalarum*
African feathergrass	*Pennisetum macrourum*
alectra	*Alectra spp.*
alfombrilla	*Drymaria arenarioides*
ambulia	*Limnophila sessiliflora*
Amur cork-tree	*Phellodendron amurense*
Amur honeysuckle	*Lonicera maackii*
anchored water hyacinth	*Eichhornia azurea*
animated oat	*Avena sterilis*
Argentine screwbean	*Prosopis strombulifera*
arrowhead	*Sagittaria sagittifolia*
Asian sprangletop	*Leptochloa chinensis*
autumn olive	*Elaeagnus umbellata*
Bell's honeysuckle	*Lonicera x bella [L. morrowii x L. tatarica]*
Benghal dayflower	*Commelina benghalensis*
Bishop's weed; goutweed	*Aegopodium podagraria*
black locust	*Robinia pseudoacacia*
black swallow-wort; Louise's swallow-wort	*Cynanchum louiseae*
Border privet	*Ligustrum obtusifolium*
borreria	*Spermacoce alata*
Brazilian satintail	*Imperata brasiliensis*
anacharis, Brazilian waterweed; Brazilian elodea	*Egeria densa; Elodea densa; Anacharis densa*
brittle water-nymph; lesser naiad	*Najas minor*
broad-leafed pepperweed; tall pepperweed	*Lepidium latifolium*
broomrape	*Orobanche spp.*
brownbeard rice; red rice	*Oryza rufipogon*
burning bush; winged euonymus	*Euonymus alatus*
bushy rock-cress; narrowleaf bittercress	*Cardamine impatiens*
Cape tulip	*Homeria spp.; Morea spp.*
Carolina Fanwort; fanwort	*Cabomba caroliniana*
catclaw mimosa	*Mimosa pigra*
cattail grass; yellow foxtail	*Setaria pallidifusca S. pallidefusca;S. pumila*
caulerpa	*Caulerpa taxifolia*

Common Name	Scientific Name
Chinese waterspinach [PERMIT REQUIRED – contact MDAR]	*Ipomoea aquatica* [PERMIT REQUIRED – contact MDAR]
coat buttons	*Tridax procumbens*
coltsfoot	*Tussilago farfara*
common barberry; European barberry	*Berberis vulgaris*
common buckthorn	*Rhamnus cathartica*
common crupina	*Crupina vulgaris*
common reed	*Phragmites australis*
creeping buttercup	*Ranunculus repens*
creeping Jenny; moneywort	*Lysimachia nummularia*
crisped pondweed; curly pondweed	*Potamogeton crispus*
crofton weed	*Ageratina adenophora*
Cypress spurge	*Euphorbia cyparissias*
Dames Rocket	*Hesperis matronalis*
devil's thorn	*Emex spinosa*
dodder	*Cuscuta spp.*
duck-lettuce	*Ottelia alismoides*
Eurasian or European water-milfoil; Spike water-milfoil	*Myriophyllum spicatum*
European buckthorn; glossy buckthorn	*Frangula alnus; Rhamnus frangula*
exotic bur-reed	*Sparganium erectum*
forget-me-not	*Myosotis scorpioides*
garlic mustard	*Alliaria petiolata*
giant false sensitive plant; false sensitive plant	*Mimosa diplotricha; M. invisa*
giant hogweed	*Heracleum mantegazzianum*
giant salvinia; eared watermoss	*Salvinia auriculata*
giant salvinia; kariba-weed	*Salvinia molesta*
giant salvinia	*Salvinia biloba*
giant salvinia	*Salvinia herzogii*
goatsrue	*Galega officinalis*
hair fescue; fineleaf sheep fescue	*Festuca filiformis*
hairy joint grass; jointhead; small carpetgrass	*Arthraxon hispidus*
hairy willow-herb; Codlins and Cream	*Epilobium hirsutum*
horned poppy; sea poppy; yellow hornpoppy	*Glaucium flavum*
hydrilla; water-thyme; Florida elodea	*Hydrilla verticillata*
itchgrass	*Rottboellia cochinchinensis*
Japanese Barberry	*Berberis thunbergii*
Japanese honeysuckle	*Lonicera japonica*
Japanese hops	*Humulus japonicus*
Japanese knotweed	*Polygonum cuspidatum; Fallopia japonica*
Japanese sedge; Asiatic sand sedge	*Carex kobomugi*
Japanese stiltgrass; Nepalese browntop	*Microstegium vimineum*
jointed prickly pear	*Opuntia aurantiaca*
kiawe	*Prosopis pallida*
kikuyugrass	*Pennisetum clandestinum*
Kodo-millet	*Paspalum scrobiculatum*
kudzu; Japanese arrowroot	*Pueraria montana*
Kyasuma grass	*Pennisetum pedicellatum*
leafy Spurge; Wolf's Milk	*Euphorbia esula*
lesser celandine; fig buttercup	*Ranunculus ficaria*
liverseed grass	*Urochloa panicoides*
longstamen rice; red rice	*Oryza longistaminata*
Malabar melastome	*Melastoma malabathricum*
melaleuca	*Melaleuca quinquenervia*
mile-a-minute vine or weed; Asiatic Tearthumb	*Polygonum perfoliatum*
mile-a-minute; bittervine	*Mikania micrantha*

Common Name	Scientific Name
mile-a-minute; heartleaf hempvine	*Mikania cordata*
Miramar weed	*Hygrophila polysperma*
missiongrass	*Pennisetum polystachyon; P. polystachion*
monochoria	*Monochoria hastata*
Morrow's honeysuckle	*Lonicera morrowii*
mosquito fern	*Azolla pinnata*
multiflora rose	*Rosa multiflora*
murain-grass	*Ischaemum rugosum*
Norway maple	*Acer platanoides*
onion weed	*Asphodelus fistulosus*
Oriental or Asiatic bittersweet	*Celastrus orbiculatus*
oxygen weed	*Lagarosiphon major*
pale swallow-wort	*Cynanchum rossicum*
parrot-feather; water-feather; Brazilian water-milfoil	*Myriophyllum aquaticum*
pickerel weed	*Monochoria vaginalis*
pilipiliula	*Chrysopogon aciculatus*
plume grass; Amur silvergrass	*Miscanthus sacchariflorus* (also covers *Miscanthus x giganteus*, a hybrid of *M. sacchariflorus* and *M. sinensis*)
porcelain-berry; Amur peppervine	*Ampelopsis brevipedunculata*
purple loosestrife	*Lythrum salicaria*
red rice	*Oryza punctata*
reed canary-grass; ribbon grass	*Phalaris arundinacea*
serrated tussock	*Nassella trichotoma*
sessile joyweed	*Alternanthera sessilis*
spotted knapweed	*Centaurea biebersteinii; C. stoebe ssp. micranthos*
sycamore maple	*Acer pseudoplatanus*
tall mannagrass; reed mannagrass	*Glyceria maxima*
tansy ragwort; stinking Willie	*Senecio jacobaea*
Tatarian honeysuckle	*Lonicera tatarica*
three-cornered jack	*Emex australis*
tornillo	*Prosopis reptans*
tree of heaven	*Ailanthus altissima*
tropical soda apple	*Solanum viarum*
turkeyberry	*Solanum torvum*
variable water-milfoil; two-leaved water-milfoil	*Myriophyllum heterophyllum*
velvet fingergrass	*Digitaria velutina*
velvet mesquite	*Prosopis velutina*
water yellowcress; great yellowcress	*Rorippa amphibia*
water-chestnut	*Trapa natans*
wetland nightshade	*Solanum tampicense*
wild blackberry complex	*Rubus fruticosus*
wild blackberry	*Rubus moluccanus*
wild chervil	*Anthriscus sylvestris*
wild safflower; jeweled distaff thistle	*Carthamus oxyacanthus; C. oxycantha*
wild sugarcane	*Saccharum spontaneum*
wineberry; Japanese wineberry; wine raspberry	*Rubus phoenicolasius*
witchweed	*Striga spp.*
wormleaf salsola	*Salsola vermiculata*
yellow floating heart	*Nymphoides peltata*
yellow Iris	*Iris pseudacorus*

On the web: **http://www.mass.gov/eea/agencies/agr/farm-products/plants/massachusetts-prohibited-plant-list.html** Updated 5/2013

Contact: Jennifer Forman Orth, State Plant Pest Survey Specialist, Jennifer.Forman-Orth@state.ma.us – 617-626-1735

Appendix
Nantucket Invasive Species Committee Plants List

Plants currently recognized by the Invasive Plant Species Committee of the Nantucket Biodiversity Initiative as invasive or at high risk of becoming invasive to native plant communities on Nantucket.

CATEGORY	SCIENTIFIC NAME	COMMON NAME
Highly Invasive	*Alliaria petiolata (=officinalis)*	Garlic mustard
	Ampelopsis brevipedunculata	Porcelainberry
	Celastrus orbiculatus	Oriental bittersweet
	Centaurea maculosa	Spotted knapweed
	Elaeagnus umbellata	Autumn olive
	Euphorbia cyparissias	Cypress spurge
	Lonicera japonica	Japanese honeysuckle
	Lonicera morrowii	Morrow honeysuckle
	Lythrum salicaria	Purple loosestrife
	Phragmites australis	Common reed
	*Pinus thunbergiana***	Japanese black pine
	Polygonum cuspidatum	Japanese knotweed
	*Polygonum sachalinese***	Giant knotweed
	P. cuspidatum x sachalinese	Hybrid knotweed
	Rosa multiflora	Multiflora rose
	Vincetoxicum nigrum	Black swallow-wort
Likely Invasive	*Ailanthus altissima*	Tree-of-heaven
	*Clematis terniflora***	Sweet autumn clematis
	*Eragrostis curvula***	Weeping lovegrass
	Glaucium flavum	Horned poppy
	Ligustrum obtusifolium	Common privet
	Pueraria Montana	Kudzu; Japanese arrowroot
	*Salix cinerea/atrocinerea***	Large gray or rusty willow
Potentially Invasive	*Acer ginnala***	Amur maple
	Aegopodium podagraria	Goutweed
	*Akebia quinata***	Chocolate vine
	*Phyllostachys spp.***	Bamboo
	Cytisus scoparius	Scotch broom
	Echinocloa crus-galli	Barnyard grass
	Epilobium hirsutum	Hairy willow-herb
	Erodium cicutarium	Stork's bill
	Glechoma hederacea	Gill-over-the-ground
	Hesperis matronalis	Dame’s rocket
	Holcus lanatus	Velvet grass

	Iris pseudacorus	Yellow flag iris
	*Ligustrum ovalifolium***	California privet
	*Ligustrum sinense***	Chinese privet
	*Ligustrum vulgare***	Common Privet
	*Miscanthus sacchariflorus and M. x gigantus***	Plume grass and hybrid plume grass
	Populus alba	White poplar
	Ranunculus repens	Creeping buttercup
	Rosa rugosa	Saltspray rose
	Solanum dulcamara	Bittersweet nightshade
	*Wisteria floribunda***	Japanese wisteria

AQUATIC PLANTS (SUBMERSED AND FLOATING)		
CATEGORY	**SCIENTIFIC NAME**	**COMMON NAME**
Likely Invasive	*Myriophyllum aquaticum*	Parrot feather
	Potamogeton crispus	Curly or crisped pondweed
	Hydrilla verticillata	Hydrilla

**=Species that are not currently listed as prohibited plants in Massachusetts, but which may have been listed as invasive in mid-Atlantic/southern states or in coastal areas, and/or have demonstrated ability to overwinter and spread on Nantucket.